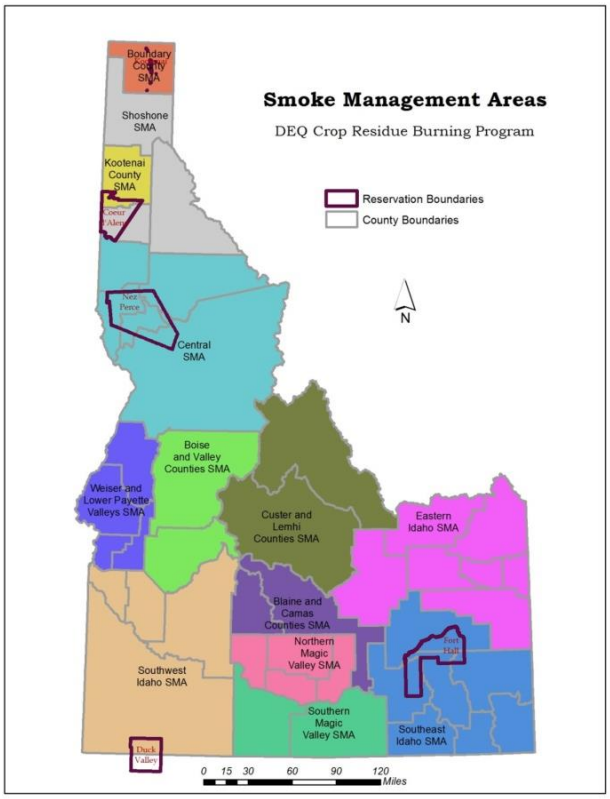
Crop Residue Burning Program
2016 Annual Report



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2016 Annual Report

April 2017

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Executive Summary

The open burning of crop residue is a historic practice in Idaho and considered an important tool for farmers. However, crop residue burning can also produce air emissions and, if not managed properly, can lead to surface level smoke impacts that may endanger human health.

This annual report reviews and analyzes the Idaho Department of Environmental Quality (DEQ) Crop Residue Burning (CRB) program for the 2016 burn seasons. DEQ is required to prepare an annual report that includes, at a minimum, an analysis of the causes of any measured air pollutant levels above the program-defined concentration thresholds and an assessment of the circumstances associated with any reported endangerment to human health associated with a crop residue burn.

This report also includes an outreach summary and analysis of the 2016 burn season, including air quality impacts, discussion of DEQ's system for complaints and compliance, air quality monitoring network, meteorological summary, and assessment of the burn-decision process and acres burned in each smoke management area (SMA).

To possibly help limit impacts to institutions with sensitive populations (ISPs), DEQ identified the need for improved coordination efforts with other airshed users, as a minor program improvement during the burn season review. DEQ has also identified useful smoke trajectory tools that could easily be included in the evaluation of smoke impacts on monitors above the program thresholds.

Burn Season Evaluation

Although most of the agriculture residue burn activity in Idaho occurs in distinct seasons, the crop residue burning program must make burn decisions for Idaho on a weekday basis throughout the year. With the introduction of the Spot Burn, Baled Agricultural Residue Burn, and Propane Flaming Permit (SBPF permit) weekends also need to be evaluated for appropriate conditions for conducting burns in this category. There were 16 SBPF permits issued in 2016. The acres burned under the SBPF program are not included in the acreage totals for the Annual CRB Program report.

Both spring and fall burn seasons began optimistically when fields started appearing ready to burn approximately two to three weeks early in several smoke management areas. Spring burning made up 12 percent of the total acreage for 2016. This is comparable to 2015 totals where 15 percent made up spring burning. Spring burning remains fairly limited as it has throughout this program's existence.

The 2016 summer burn season was influenced by a hot and very dry summer, and periodic wetting rains. Wildfire smoke impacts across central Idaho caused some burning limitations and record breaking precipitation in October also limited burning in Boundary and Central SMA's.

Southeast Idaho SMA had multiple fire safety burn bans in effect starting in July and continuing through the beginning of October causing a delay in burning.

The annual total CRB acreage for 2016 was 39,578 acres. This total is comparable to 37,462 acres burned under this program in 2015, when wildfire smoke impacted Idaho and limited burn days. Wildfire activity, meteorological conditions and crop rotations are a few factors that continue to reduce Idaho's agriculture residue burning activity well under our program maximum of 67,416 acres in 2012. In 2012 there were a large number of Conservation Reserve Program (CRP) acres which accounted for much of the increased acreage.

Air Quality Evaluation

DEQ operates the CRB program under specific guidelines and procedures designed to protect public health, avoid adverse impacts to institutions with sensitive populations, and avoid public roadway safety hazards. These guidelines and procedures are included in the DEQ document titled Crop Residue Burning Operating Guide (Op Guide). The Op Guide is reviewed annually to provide DEQ with an opportunity to update procedures based on the lessons learned in the field and any improvements in smoke management techniques discovered since the previous update. DEQ carefully evaluates the program's effectiveness in meeting these goals and adherence to the established procedures. The evaluation process is explained in detail within this report.

A thorough evaluation of the 2016 burn season air quality data indicates approved crop residue burning possibly contributed to measured air pollutant concentrations exceeding the program defined postburn concentration thresholds. (See section 4.1 of this report for additional information). Areas of possible improvement are identified in the sections that follow. There were eight instances during the year where pollutant concentrations exceeded program defined post burn concentration thresholds on DEQ approved burn days. Following extensive evaluation of the meteorology, timing of DEQ approved burns, and the field locations, it was determined that DEQ approved crop residue burning may have contributed to these impacts. A review of these instances reveals additional coordination efforts with other airshed users is necessary for future burn days. No health concerns were reported resulting from any approved crop residue burning in 2016.

1. Introduction

This report reviews and analyzes the Idaho Department of Environmental Quality (DEQ) crop residue burning (CRB) program for the 2016 burn season. DEQ is required by the "Rules for the Control of Air Pollution in Idaho" (IDAPA 58.01.01.622.02) to prepare an annual report that includes, at a minimum, an analysis of the causes of any exceedance of the program-defined ambient air Pollutant Concentration Thresholds (PCT) and an assessment of the circumstances related to any reported endangerment to human health associated with a crop residue burn. This report summarizes program updates undertaken in 2016, outreach efforts over the past year, an analysis of the 2016 burn season, and suggested program improvements necessary to prevent future instances of measured pollutant concentrations above the PCT. Additional program improvements requested by the DEQ Director may be included when applicable.

2. Program Updates

During the Annual CRB Advisory Committee meeting held in Boise on March 9, 2016, three program improvement recommendations were made. These recommendations were supported by DEQ's Director and included in the 2015 CRB Annual Report. DEQ implemented the following based on the recommended improvements:

- **ISP updates** – The Committee recommended DEQ develop a process to ensure the location of ISPs is accurate. DEQ committed to evaluate the workload and resources available for this task and determine an appropriate frequency. - DEQ developed a process to ensure the ISP locations are accurate. DEQ will focus on one section (e.g., schools, hospitals, assisted living facilities, or nursing homes) of the list each year to contact and update information. DEQ evaluated the workload and resources available and determined the entire list would not be able to be verified on an annual basis. For the 2016 burn season, DEQ continued to add new ISP's to the GIS database when discovered, and confirmed existing ISP hospital locations. Based on our efforts in 2016 DEQ estimates 300 ISPs can be contacted and updated each year. DEQ will confirm other sections in the coming years at a completion target of 300 per year. DEQ field staff will continue to verify ISP's within three miles of fields while attending field burns.
- **Wildfire response coordination** – The Committee recommended DEQ work closely with the Idaho Department of Lands, Federal Land Managers, and other fire agencies to develop a process to ensure agricultural fields regulated under the CRB program may be included in the management response to a wildfire. - DEQ worked closely with the Idaho Department of Lands, Federal Land Managers, and other fire agencies during the 2015 burn season to ensure agricultural fields regulated under the CRB program were not restricted from being burned as part of a fire fighting strategy in response to a wildfire. This first coordinated effort in 2015 paved the way for open communication between the fire agencies and DEQ. The DEQ CRB Program will attempt to establish communication with wildfire response management during the initial stages of a wildfire where the potential for using crop land to establish fire breaks as a management response is identified by DEQ. DEQ will train staff on recognition when future wildfires may potentially interface with cropland to ensure a quick response. This should limit potential

delays if wildfire response needs to use CRB registered acreage to manage wildfire growth.

- **Ozone standard and CRB program concentration thresholds** – The Committee recommended DEQ initiate negotiated rulemaking in May 2016 to modify IDAPA 58.01.01.621.01 as it relates to the requirement of 75% of the NAAQS. - Through the negotiated rulemaking process, DEQ developed a proposed rule that gives DEQ the authority to allow crop residue burning when ozone levels are not exceeding, or expected to exceed, 90% rather than 75% of the ozone NAAQS. This new 90% level is still protective of the ozone NAAQS, and also provides farmers the ability to burn while following smoke management best practices. This rule was promulgated under Docket No. 58-0101-1601. As an outgrowth of the negotiations, DEQ also developed an interim rule that allows the CRB Program to continue operating under the 2008 ozone NAAQS until EPA approves the new 90% ozone level in a revised State Implementation Plan (SIP). This rule was promulgated separately under Docket No. 58-0101-1604.

  Before the Board of Environmental Quality (Board) can adopt the rule, it is necessary to revise Idaho Code § 39-114 for consistency with the revisions in this proposed rule docket. DEQ submitted draft proposed legislation to the 2017 Legislature. The legislation was passed by the Legislature and approved by the governor, it became effective immediately. DEQ presented the final rule proposal to the Board on March 16, 2017. The Rule was adopted.

3. Outreach for the 2016 Burn Season

Outreach remains an important component of the CRB program. DEQ's outreach effort has two main objectives: public awareness and grower education. Many previously used outreach methods were used again in 2016. These methods included distributing brochures; providing telephone hotlines; maintaining an internet website with public and grower sections; maintaining an e-mail list service; communicating directly with fire and sheriff departments; providing information at agricultural expos and county fairs; and visiting institutions with sensitive populations (ISP), such as schools, hospitals, and assisted living facilities. DEQ conducted the following outreach methods in 2016:

- ***CRB online grower training***

  DEQ worked throughout the year to update the CRB online grower training. The updated CRB online training was completed and posted online on December 8, 2016. Since the online grower training was updated, several new users have completed training.

- ***Grower education***

  On-site field assistance continues to be an effective outreach technique for DEQ as it provides an opportunity to meet growers, develop a positive working relationship, and emphasize good burning strategies and techniques.

Many growers who routinely burn each year are familiar with the CRB program and navigate the registration process, coordinate with the field staff and successfully accomplish their annual goals. However, we continue to invest extra time each year with growers who are new to the program, have never completed a registration, have not participated in the program for several years, or do not have internet access. DEQ sees about 20 new participants each year. Many participants are infrequent burners only completing burns once every 5 years or less. Our grower education continually emphasizes that obtaining all necessary fire safety permits and consulting with the Idaho Transportation Department or applicable county road department regarding public roadway safety requirements, well ahead of a projected burn date, will help accelerate when a burn is scheduled.

- ***Public outreach through mass media***

  DEQ used radio advertisements and social media posts this year to reach members of the public and growers who may not have been reached by previous outreach methods. These efforts included radio public service announcements (PSAs) in which DEQ used two advertisements: one intended for the public and one intended for the grower community. The PSAs provided crop residue burning information for growers and citizens along with contact information for DEQ. The social media posts provided detailed information for crop residue burning including the training and permits required.

- ***Collaboration with fire departments***

  DEQ regional staff regularly meets with local fire officials to discuss CRB and other open burning rules to help ensure that fire department personnel and DEQ are providing the public with consistent and accurate information about the CRB program.

- ***Outreach to ISP***

  Each off-season, DEQ representatives contact many ISPs, with an emphasis on those ISPs in areas where we have approved burns or anticipate approving burns in the future. This outreach, either in person or by telephone, gives DEQ an opportunity to explain the CRB program; confirm the ISP location, status, and contact person; and provide DEQ contact information to the ISP. During the burn season, as part of DEQ's field observation exemption procedure, ISP's must be contacted before the start of any burn within 3 miles of a field that is approved to be burned without DEQ being present. This outreach provides DEQ another opportunity to explain the program and provide contact information, as well as to provide information about the nearby burning that has been approved for that day.

  DEQ staff obtained a list of all licensed hospitals in the state of Idaho and verified the list in the CRB database as part of the ISP effort mentioned in Section 2. The CRB database provides this critical information for each permit when issued.

4. Burn Season Analysis

To manage the CRB program, the state is divided into 13 smoke management areas (SMA) based on the similarity of meteorological conditions and topography, presence or absence of CRB activity, as well as proximity to DEQ regional offices (Figure 1). This burn season analysis includes examining statewide air quality impacts, complaints, compliance and enforcement, monitoring network, meteorology, and specific summaries for each SMA.

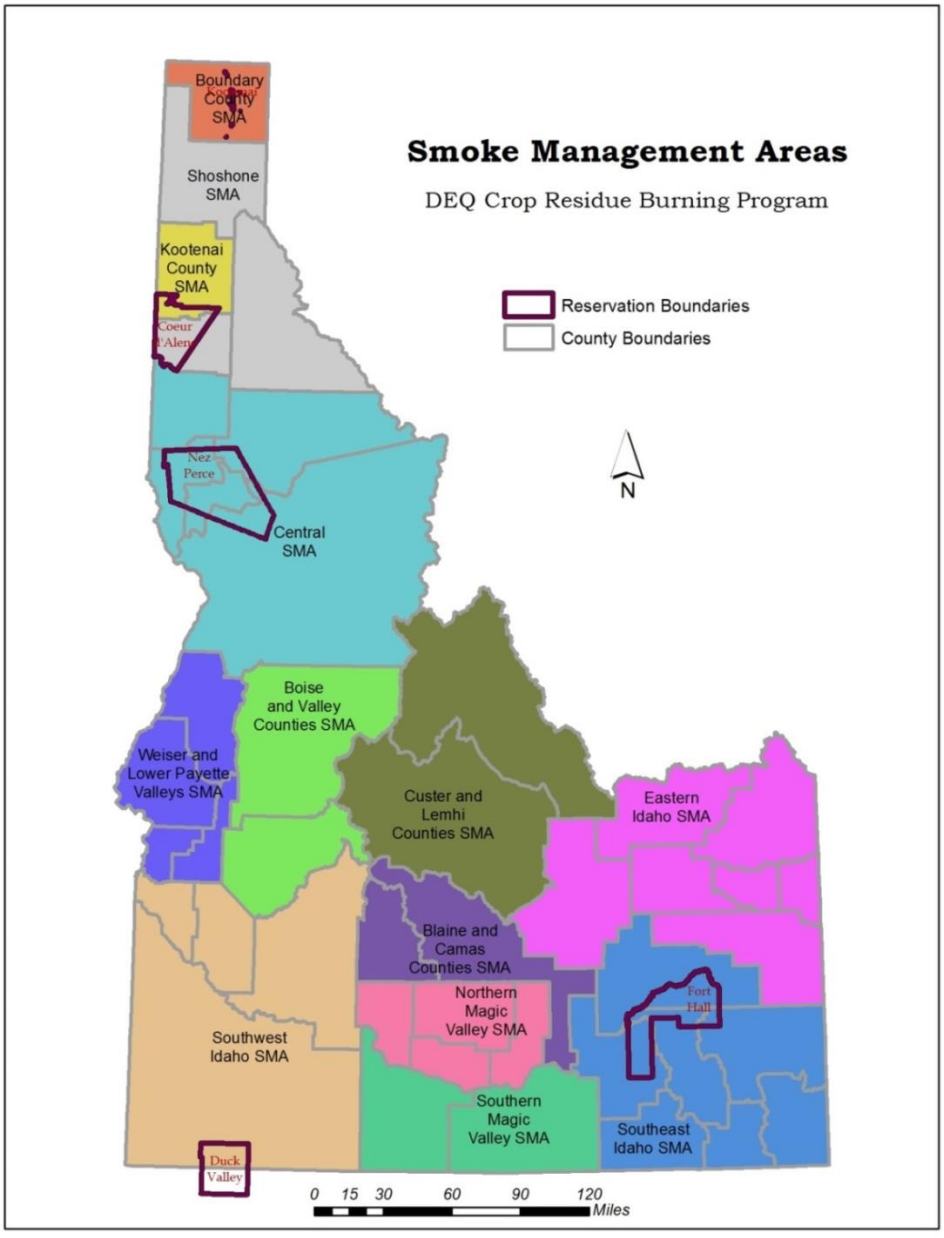

Figure 1. Idaho smoke management areas.

The SMA summaries include area geography descriptions, acres burned, daily burn decisions, and air quality conditions in 2016. No permitted crop residue burning was conducted in the Boise and Valley Counties SMA, Shoshone SMA, and the Custer and Lemhi Counties SMA during 2016; further discussion of these SMA is not included.

4.1 Air Quality Impacts

This section evaluates CRB program compliance with program concentration thresholds (PCT), circumstances surrounding approved burning on days when measured pollutant concentrations were above the PCT, and possible adverse impacts to ISPs. DEQ evaluated burn days in two circumstances: (1) when approved burning was conducted within the same SMA as a monitor that measured fine particulate matter ($PM_{2.5}$) or ozone concentrations above the preburn or postburn threshold levels, and (2) to evaluate possible public roadway safety visibility impacts.

4.1.1 Program Concentration Threshold Compliance

To approve a request to burn, DEQ must determine that ambient air quality levels meet three criteria: (1) do not exceed 75% of the level of any National Ambient Air Quality Standards on any day; (2) are not projected to exceed such level over the next 24 hours; and (3) have not reached and are not forecasted to reach and persist at 80% of the 1-hour action criteria for particulate matter. The PCT for the pollutants of concern for crop residue burning—given as micrograms per cubic meter ($\mu g/m^3$) of $PM_{2.5}$ or PM_{10} or parts per billion (ppb) of ozone—are defined as follows:

- $PM_{2.5}$ 1-hour average (64 $\mu g/m^3$)
- $PM_{2.5}$ 24-hour average (26.25 $\mu g/m^3$)
- PM_{10} 1-hour average (308 $\mu g/m^3$)
- PM_{10} 24-hour average (112 $\mu g/m^3$)
- Ozone 8-hour average (56 ppb)

During 2016, ambient air quality monitors across Idaho recorded values above the PCT in many instances. However, on many of these days, no crop residue burning was approved. For purposes of this report DEQ did not evaluate days when no crop residue occurred. For days when measured $PM_{2.5}$ or ozone levels were above the PCT and crop residue burning was approved and conducted, DEQ evaluated the location of the permitted burns, timing of the burn, and weather conditions in relation to the air quality monitoring data to determine if the air quality impacts could be attributed to DEQ approved burns. These reviews help to identify potential areas of improvement to the program or decision making processes.

Burning under the CRB program was reasonably suspected to have caused or contributed to a measured concentration above a PCT only when both of the following conditions were true:

- An approved crop residue burn occurred during, or prior to, the recorded concentration.
- Wind direction and proximity of the burn were such that smoke from the burn was transported toward the monitor.

DEQ relies upon a network of air quality monitors to evaluate compliance with PCT, and monitors within this network that recorded values above PCT have been identified in the

discussion that follows. This monitoring network is detailed in the Crop Residue Burning Program Operating Guide, and includes a statewide network of real-time and continuous $PM_{2.5}$ monitors, and includes a combination of in-state and out-of-state ozone monitors. In addition to monitoring data from this network, daily forecasting and burn decisions also incorporate ozone forecast model data from the National Weather Service (NWS) and Washington State University. Air quality monitors where negligible burning occurs and air quality monitors not owned and operated by DEQ were not evaluated for PCT exceedances in 2016. Data from air quality monitors operated by the Nez Perce Tribe, Kootenai Tribe of Idaho are incorporated into daily forecasting and burn decisions.

In addition to the PCTs described above, DEQ further evaluated the effectiveness of the CRB program by using the PM2.5 4-hour average concentration preburn and postburn triggers of 22 µg/m3 and 32 µg/m3, respectively; the PM2.5 24-hour average concentration preburn trigger of 16 µg/m3; and possible visibility hazards on public roadways. The 4-hour average concentrations can help to identify potential particulate sources that have a duration lasting longer than 1 hour but less than 24 hours, which is a typical time frame for a crop residue burn.

Ozone monitors are widely dispersed (three of the monitors used for southern Idaho are not in Idaho, and the monitor used for northern Idaho is in Spokane, Washington), so approved crop residue burning is typically at least 50 miles, and in many cases 100 miles or more, from any ozone monitor. DEQ utilizes ozone models to assist with forecasting ozone concentrations. DEQ considers smoke from crop residue burning to have little if any impact on ozone concentrations.

4.1.2 Evaluation of Burn Days

The following days are discussed because approved crop residue burning was conducted, and monitoring values were recorded at concentrations above the PCT described above. DEQ uses wind data and observations by field staff to help determine if DEQ approved burning is reasonably suspected to have caused or contributed to the measured concentrations above a PCT. It is important to note program thresholds are not NAAQS. Modeling tools to estimate smoke trajectories based on measured atmospheric data are becoming more readily available and simpler to use. These tools will be considered for subsequent year's evaluations.

June 21—8-Hour Ozone Concentration St. Lukes Monitor in Southwest SMA

June 21 was a burn day in Southwest Idaho SMA, where 1 acre was burned. Models forecast ozone at 48 ppb. Ozone was expected to be slightly higher as models for the past few days had been approximately 5 ppb lower than actual concentrations. Ozone was forecast at 54 ppb by DEQ. Actual concentrations for highest 8 hour average were 55.4 ppb at White Pine and 61.8 ppb at St. Luke Meridian. Due to the size, location, wind direction and understanding of the effect of smoke from crop residue burning on ozone at this time, elevated ozone concentrations were not likely due to approved crop residue burning. At this level of ozone concentration forecasting is challenging.

August 4—8-Hour Ozone Concentration St. Lukes Monitor in Southwest SMA

August 4 was a burn day in Southwest Idaho SMA, where 50 acre was burned. Models forecast ozone at 56 ppb. Ozone was expected to be slightly lower as models for the past few days had

been approximately 5 ppb higher than actual concentrations. Ozone was forecast at 54 ppb by DEQ. Actual concentrations for highest 8 hour average were 59.6 ppb at White Pine and 60.7 ppb at St. Luke Meridian. Due to the size, location, wind direction and understanding of the effect of smoke from crop residue burning on ozone at this time, elevated ozone concentrations were not likely due to approved crop residue burning. At this level of ozone concentration forecasting is challenging.

August 24—4-Hour Pre-Burn Average $PM_{2.5}$ Concentration, Monitor in Blaine and Camas Counties SMA

August 24 was a burn day in the Blaine and Camas Counties SMA, where 25 acres were burned in one field located in Blaine County. The $PM_{2.5}$ monitor in Ketchum reported a preburn 4-hour average concentration of 24.1µg/m^3 for the hour ending at 5:00 a.m. Enhanced documentation was conducted prior to the burn window to record the decision making process. Crop residue burning was approved because of a forecasted inversion lift that would return the $PM_{2.5}$ to below PCT levels prior to burning. Burning did not begin until 1pm when air quality had improved. The Ketchum monitor recorded a 4-hour average concentration of 8.65µg/m^3 for the hour ending at 12:00 p.m. DEQ staff observed the burns and noted that surface winds kept smoke away from the local ISPs.

September 13—1 Hour and 4-Hour Average PM2.5 Concentration, Idaho County in Central SMA

September 13 was a burn day in Central SMA, where 832 acres over 9 fields were burned in Idaho County. The south Clearwater airshed ventilation forecast depicted marginal ventilation for the area until 1:00 p.m. when good ventilation was then expected to arrive. Surface wind direction was forecasted to be northeast at 5 to 10 mph. Transport winds were also forecasted for northeast at 5 to 10 mph as well. At 6:00 p.m. the Cottonwood monitor exceeded the 1 hour post burn concentration threshold of 64µg/m3 and also the 1 hour ISP threshold of 26.25µg/m3. The 1 hour post burn PCT exceedance lasted until 8:00 p.m. The 4 hour post burn concentration threshold of 32µg/m3 was also exceeded at Cottonwood between 7:00 p.m. and 9:00 p.m. with readings as high as 46.85µg/m3. The Grangeville monitor exceeded the post burn 1 hour ISP PCT at 5:00 p.m. and again at 9:00 p.m. with readings of 29.00 and 28.00µg/m3 respectively. Approved DEQ agriculture burning and other burning activity not regulated through DEQ's CRB Program is reasonably suspected to have caused or contributed to the measured concentrations above the PCT per operating guide definition. Better coordination and communication with other airshed burners will help to alleviate future concentrations above program thresholds.

September 20—24-Hour Average Pre-Burn $PM_{2.5}$ Concentration, Franklin Monitor in Southeast SMA

September 20 was a burn day in the Southeast SMA, where 274 acres were burned over five fields in Caribou County. The $PM_{2.5}$ monitor in Franklin reported a preburn 24-hour average concentration of 16.04µg/m^3 for the hour ending at 8 a.m. Enhanced documentation was conducted to record the decision making process. DEQ determined that the elevated concentrations were possibly due to construction in the area. The approved burn was not expected to cause or contribute to any elevated concentrations at this monitor location. The approved burns were approximately 30 to 35 miles to the north of the Franklin monitor. Winds

were measured out of the west southwest during the burn window. $PM_{2.5}$ concentrations decreased during the burn window.

4.1.3 Institutions with Sensitive Populations

DEQ is prohibited from approving a request to burn if conditions will adversely impact ISP or if the plume is predicted to impact such institutions. To safeguard these populations, DEQ uses many procedures, such as maintaining a current database of all known ISPs that includes the name, type of institution, and location; reviewing all registrations for field location relative to the location of ISPs; attaching restrictive permit conditions for all fields within 3 miles of an ISP; and requiring that DEQ personnel be on site and provide final approval to burn for fields within 3 miles of an ISP (with some exceptions). DEQ field coordinators frequently conduct an in-person examination of the ISPs that are near proposed crop residue burns before ignition to ensure that the location and operational status of the ISP is accurate.

DEQ uses the following procedure to evaluate whether an adverse impact to an ISP occurred following an approved burn.

- When a monitor is present and the maximum hourly $PM_{2.5}$ concentration is below 20 µg/m^3 (or visibility is at least 10 miles if no monitor is available):
  - Conclude that no adverse impact occurred.
  - If a complaint is received from an ISP, full evaluation and enhanced documentation will be completed. No additional documentation is needed unless DEQ receives a complaint from an ISP.
- When a monitor is present and the maximum hourly $PM_{2.5}$ concentration is between 20 and 26.25 µg/m^3:
  - Conclude adverse impact unlikely.
  - Brief evaluation is needed to determine whether an adverse impact occurred. The following items will be reviewed for the evaluation:
    - Monitoring data
    - Weather data
    - Field notes
  - If a complaint is received from an ISP, enhanced documentation and evaluation will be completed.
- When a monitor is present and the maximum hourly $PM_{2.5}$ concentration is greater than 26.25 µg/m^3 (or visibility is less than 10 miles if no monitor is available):
  - Adverse impact possibly occurred.
  - Full enhanced documentation and evaluation will be completed to determine whether an adverse impact occurred:
    - Monitoring data
    - Weather data
    - Field notes
    - Contact ISP to ask questions identified on the enhanced documentation form. ISP responses documented.

Discussed below are days when approved crop residue burning was conducted and an ambient air quality monitor located at or near an ISP (such as St. Luke's Hospital in Meridian) recorded a 1-hour average $PM_{2.5}$ concentration of 26 µg/m^3 or more.

April 18-Boundary SMA

April 18 was a burn day in Boundary County. Two fields were burned within 3 miles of the Mt. Hall Elementary School. The first field, 32 acres cereal stubble, was completed with no issues. The second field, 70 acres cereal stubble, was ignited at 1:40 p.m. with DEQ staff on site. The temperature was 74 degrees, humidity 34% with west-north west winds at 2 to 4 mph. by 2:20 p.m. the field was mostly out with the main plum transporting out to the north-north west. At 2:25 p.m. DEQ staff was located at the Mt. Hall School and noticed a wind shift to a west wind. The monitor at Mt. Hall School recorded readings of 38 ug/m3 at 3 p.m. and 28.8 ug/m3 at 4 p/m. by 5 p.m. concentrations were below program threshold at 7.6 ug/m3. Full evaluation of the possible adverse impact to an intuition with sensitive populations was conducted. Unforeseeable surface wind shifts are difficult to forecast in the Boundary SMA due to the topography of the area. DEQ staff will work to improve forecasting skills to minimize future impacts. Timing of burn to conclude prior to valley drainage winds may be a consideration.

July 28—Idaho County in Central SMA

July 28 was a burn day in Idaho County. 1 field 100 acres in size was burned at 1:00 p.m. The $PM_{2.5}$ monitor in Cottonwood recorded 1 hour readings of 28.21µg/m3 at 2:00 p.m. and 42.85µg/m3 at 7:00 p.m. The approved burn was located approximately 18 miles east south east of Cottonwood. The surface wind direction measured at the time of the exceedance was north east. Approved DEQ agriculture burning and other burning activity not regulated through DEQ's CRB Program is reasonably suspected to have caused or contributed to the measured concentrations above the PCT per operating guide definition. Better coordination and communication with other airshed burners will help to alleviate future concentrations above program thresholds.

September 12—Idaho County in Central SMA

September 12 was a burn day in Idaho County. 1 field 65 acres in size was burned at 1:00 p.m. The $PM_{2.5}$ monitor in Cottonwood recorded 1 hour readings of 33.01µg/m3 at 3:00 p.m. The approved burn was located approximately 8 miles south east of Cottonwood. The surface wind direction at the time of the exceedance was northeast. Smoke from this burn transported well south of the Cottonwood monitor as reported by DEQ field staff. Due to the DEQ approved burning finishing up for the day by 1:30 p.m., the surface and transport wind direction and observations of other burning activity, approved DEQ agriculture burning and other burning activity not regulated through DEQ's CRB Program is reasonably suspected to have caused or contributed to the measured concentrations above the PCT per operating guide definition. Better coordination and communication with other airshed burners will help to alleviate future concentrations above program thresholds.

September 13—1 Hour and 4-Hour Average PM2.5 Concentration, Idaho County in Central SMA

September 13 was a burn day in Central SMA, where 832 acres over 9 fields were burned in Idaho County. The south Clearwater airshed ventilation forecast depicted marginal ventilation for the area until 1:00 p.m. when good ventilation was then expected to arrive. Surface wind direction was forecasted to be northeast at 5 to 10 mph. Transport winds were also forecasted for northeast at 5 to 10 mph as well. At 6:00 p.m. the Cottonwood monitor exceeded the 1 hour post burn concentration threshold of 64µg/m3 and also the 1 hour ISP threshold of 26µg/m3. The 1 hour post burn PCT exceedance lasted until 8:00 p.m. The 4 hour post burn concentration threshold of 32µg/m3 was also exceeded at Cottonwood between 7:00 p.m. and 9:00 p.m. with readings as high as 47µg/m3. The Grangeville monitor exceeded the post burn 1 hour ISP PCT at 5:00 p.m. and again at 9:00 p.m. with readings of 29.00 and 28µg/m3 respectively. Due to the DEQ approved burning finishing up for the day by 2:00 p.m., the surface and transport wind direction and observations of other burning activity, approved DEQ agriculture burning and other burning activity not regulated through DEQ's CRB Program is reasonably suspected to have caused or contributed to the measured concentrations above the PCT per operating guide definition. Better coordination and communication with other airshed burners will help to alleviate future concentrations above program thresholds.

September 20—Idaho County in Central SMA

September 20 was a burn day in Idaho County. Four fields totaling 204 acres were burned. The $PM_{2.5}$ monitor in Cottonwood recorded 1 hour readings of 28µg/m3 at 4:00 p.m. and 45.6µg/m3 at 5:00 p.m. The $PM_{2.5}$ monitor in Grangeville recorded 1 hour reading of 32µg/m3 at 4:00 p.m. The approved burn was approximately 7 miles south of Cottonwood and 9 miles east of Grangeville. The wind direction at the time of the exceedance was north northwest. The surface and transport wind direction and observations of other burning activity, approved DEQ agriculture burning and other burning activity not regulated through DEQ's CRB Program is reasonably suspected to have caused or contributed to the measured concentrations above the PCT per operating guide definition.

Because of cool temperatures at the time of the burn, 11:00 a.m., 54 degrees, high humidity, 63% and 95% cloud cover which all worked together to inhibit vertical lift and ventilation, the source of the elevated $PM_{2.5}$ concentration at Grangeville was possibly due to DEQ approved crop residue burning. Surface wind direction was N-NW which was good for that field. If crop residue burning is approved in the future under similar meteorological conditions, a small test burn would be advisable to test vertical lift, ventilation and transport direction.

September 26—Idaho County in Central SMA

September 26 was a burn day in Idaho County. Three fields 162 acres in size were burned. The $PM_{2.5}$ monitor in Grangeville recorded 1 hour reading of 31µg/m3 at 3:00 p.m. The approved burns were approximately 5.5 miles north east of Grangeville and 1 mile North of Grangeville. The wind direction at the time of the exceedance was south west. Due to poor ventilation burning was shut down at noon. Approved DEQ agriculture burning and other burning activity not regulated through DEQ's CRB Program is reasonably suspected to have caused or contributed to the measured concentrations above the PCT per operating guide definition. Better coordination

and communication with other airshed burners will help to alleviate future concentrations above program thresholds.Public Roadway Impacts

August 19—Public Roadway in Northern Magic Valley SMA

August 19 was a burn day in the Northern Magic Valley SMA. A 71-acre field was approved to burn in Minidoka County to the west of North 400 West road. A DEQ field coordinator was on site to observe the burn. The DEQ field coordinator measured the wind direction as predominantly from the east from 7 to 9 mph. The grower was prepared with flaggers; however there was a miscommunication and ignition began before the flaggers were in place. Smoke caused reduced visibility for motorists for approximately 10 minutes. DEQ highlighted that communication is vital between the burners and flaggers.

September 14—Public Roadway in Central SMA

September 14 was a burn day in Central SMA. A 50-acre field was approved to burn in Nezperce County adjacent to the Southwick Cavindish highway. A DEQ field coordinator was on site to observe the burn. The DEQ field coordinator measured the wind direction as predominantly from the south southwest at 4 to 6 mph. The grower was prepared with flaggers if needed. Midway through the burn there was an unanticipated wind shift that reduced visibility on the highway for approximately 20 minutes. As soon as the smoke shifted toward the highway the flaggers moved into position on each end of the burn.

4.2 Complaints

Complaint response remains a critical part of DEQ's CRB program. Like information from ambient monitoring or meteorological data, complaints provide smoke managers with information that help them understand how the public perceives burning, air quality, and smoke behavior. DEQ uses complaint information such as location, content, and circumstances to improve future burn decisions. Some complaints involve smoke from crop residue burning conducted within the CRB program. Other complaints involve crop residue burning conducted outside DEQ's CRB program, such as the burning of an unregistered field, burning on a no-burn day, or crop residue burning conducted on tribal land, as well as complaints regarding prescribed burning and wildfire smoke.

This year, DEQ used a familiar toll-free hotline number for the public to submit questions, comments, and complaints. DEQ, in cooperation with the Nez Perce and Coeur d'Alene Tribes, used a contractor to answer the calls. Information from each call was immediately e-mailed to CRB program staff to provide immediate feedback for burn coordinators considering burn decisions throughout the day. Complaints received through the hotline included complaints about burning conducted within and outside the CRB program. The following information was collected from the callers:

- Name
- Phone number
- Is a call back requested?
- City, state, and county of caller's location

- Is smoke visible from caller's location?
- Is smoke at ground level?
- Brief description of the problem

In addition to the complaint hotline, DEQ also directly received questions, comments, and complaints in the regional offices, and some complaints were received by DEQ field coordinators. In all cases, crop residue burning complaints were entered into DEQ's Complaint Tracking System by regional office staff. DEQ staff responded to all complaints received and contacted the complainants directly. Table 1 shows the total number of crop residue burning complaints received by SMA, including those related to DEQ's CRB program and those from non-DEQ crop residue burning and other smoke complaints.

Although complaints may occur when burning occurs some complaints are general in nature and do not provide real-time feedback for decision making or report health impacts.

Table 1. Summary of complaints responded to by the CRB program during 2016.

Smoke Management Area[a]	Total Crop Residue Burning Related Complaints	Complaints Likely Associated with Approved Crop Residue Burning	Complaints Associated with Other Smoke Sources[b]
Central	11	6	5
Boundary, Kootenai	12	6	6
Southeast Idaho	1	0	1
Southwest Idaho	3	0	3

a. Smoke management areas with no related complaints during 2016 are not included.
b. Complaints from other sources include other open burning within DEQ jurisdiction, open burning outside DEQ jurisdiction, and wildfires.

4.3 Compliance and Enforcement

DEQ's existing Air Quality Division Compliance and Enforcement Program is used for the CRB program. DEQ continued to focus on compliance assistance during 2016, with the goal of educating growers that are new to the program about their permits and requirements and helping them to understand how to comply with those requirements. In instances where a violation was documented and an enforcement action was appropriate, DEQ continued to use both informal and formal enforcement tools.

During 2016, DEQ issued nine notices to comply (NTCs) for minor violations of the CRB rules. These minor violations included one for limited visibility on roadways and one for burning without approval. Seven NTC's were issued to growers new to the program for failure to obtain a permit. Five new growers were from southeastern Idaho and two from central Idaho. Additional outreach efforts in these areas will be pursued in 2017.

4.4 Crop Residue Burning Ambient Air Quality Monitoring Network

DEQ continued to operate the existing air quality monitors and additional seasonal CRB PM2.5 monitors during 2016. Figure 2, Figure 3, and Figure 4 show the locations of monitors in the northern, central, and southern Idaho SMAs, respectively.

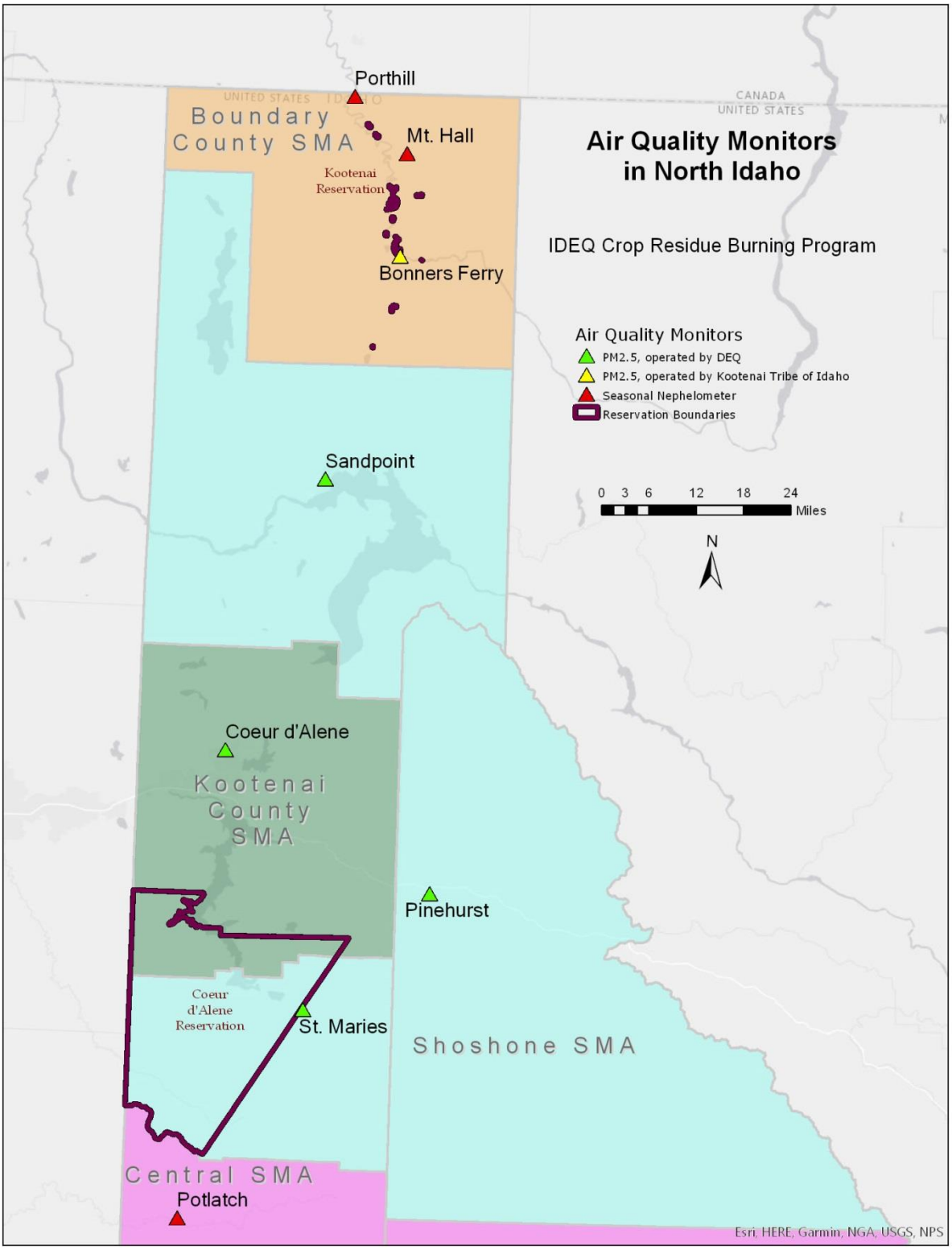

Figure 2. Air quality monitor locations for Northern Idaho SMA.

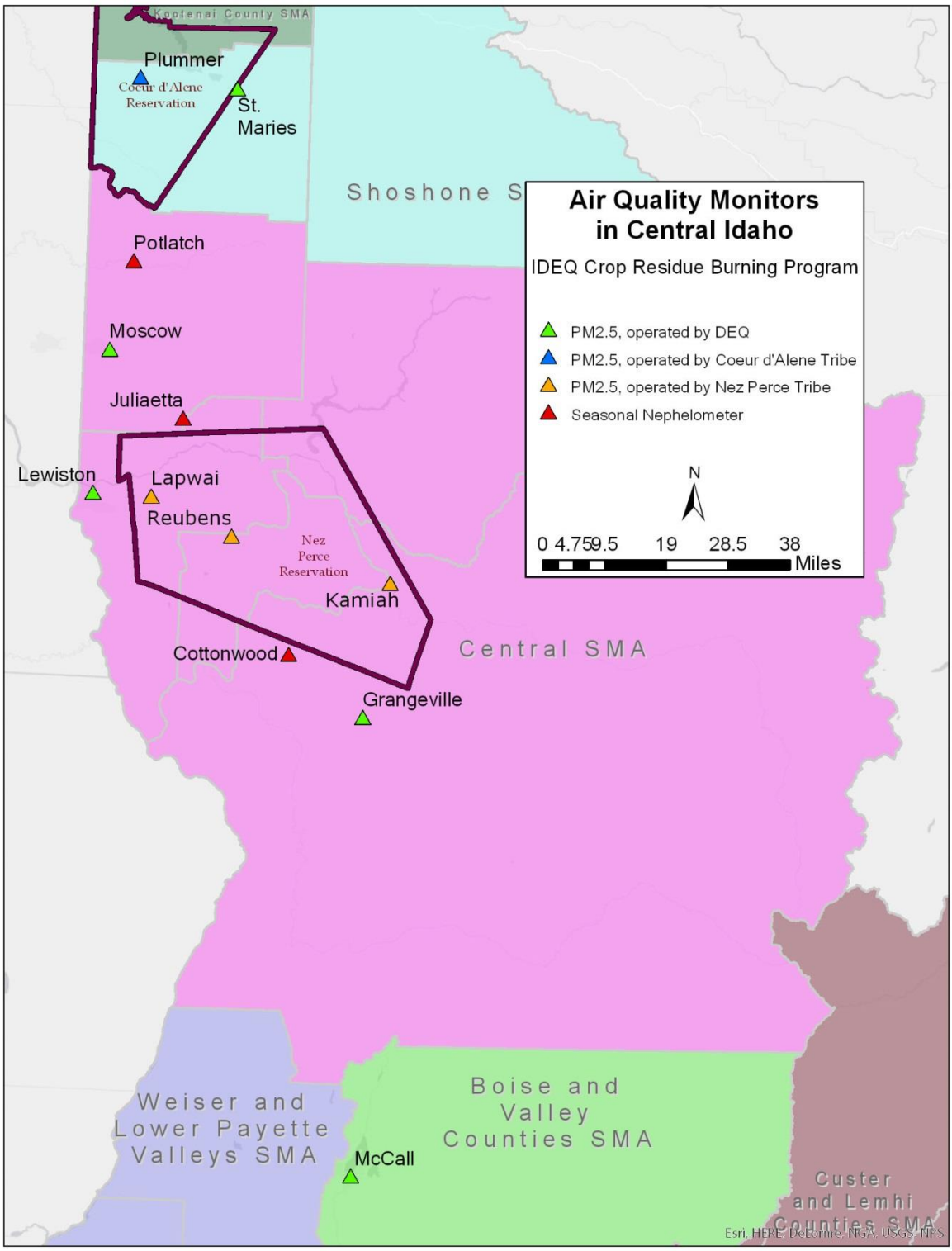

Figure 3. Air quality monitor locations for the Central SMA.

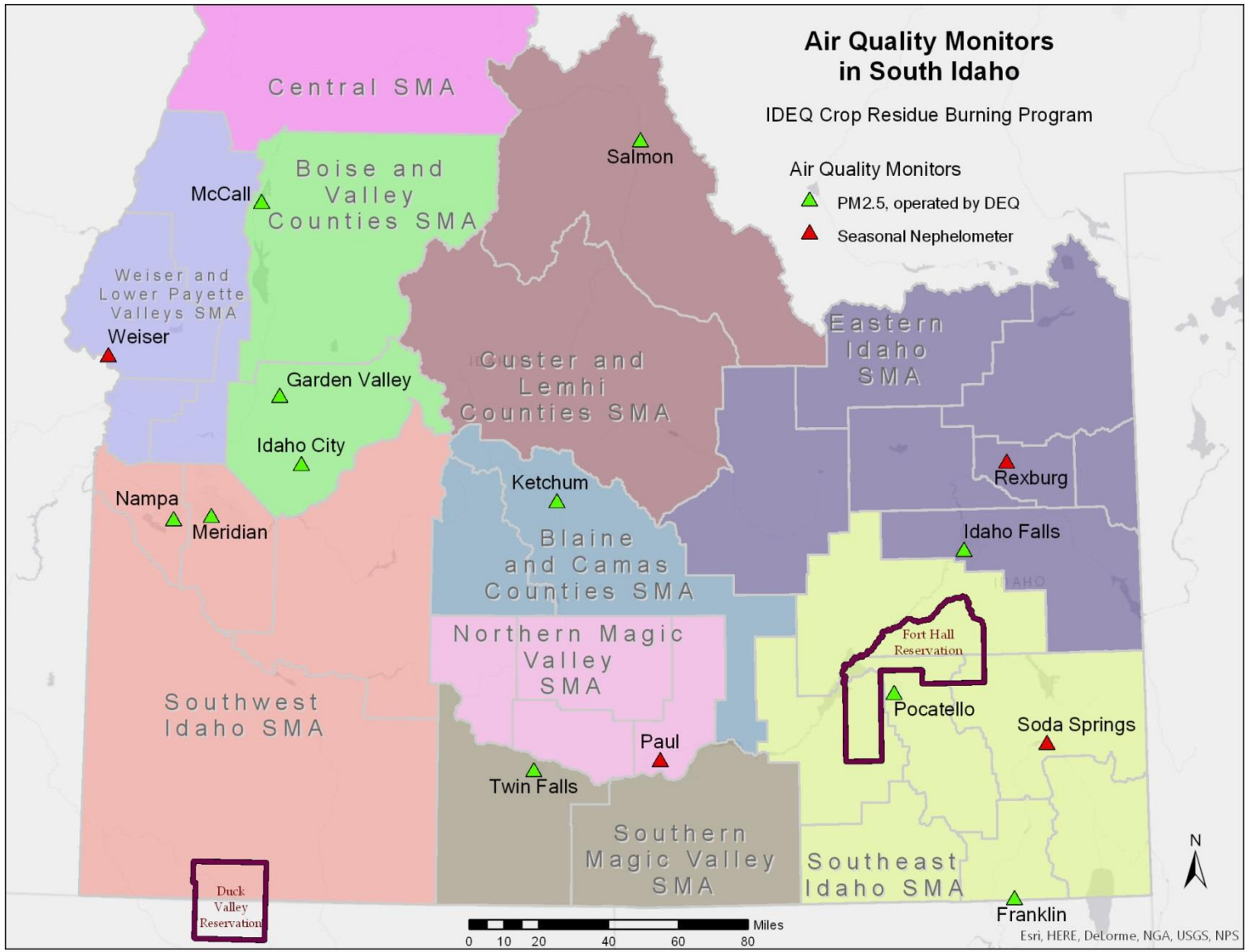

Figure 4. Air quality monitor locations for Southern Idaho SMA.

4.5 Meteorology

The CRB program meteorologist and regional coordinators use a variety of weather forecasting tools and evaluate many parameters during the burn decision process, including surface wind speed and direction, atmospheric mixing height, transport wind speed and direction, temperature, relative humidity, cloud cover, and probability of precipitation. In addition, DEQ field coordinators conduct *in-the-field* observations of meteorological conditions to assist in prediction of smoke dispersion conditions.

Appendix A contains detailed summaries of the meteorological conditions throughout the state during the fall burn season.

4.6 Smoke Management Area Summaries

Detailed summaries of each SMA are included in this section. During 2016, 39,578 acres of residue were burned statewide under the CRB program. The majority of the burning (87%) occurred during the fall burn season.

For this review acres burned under the CRB program are broken down by burn season and crop type. Crop types include Kentucky bluegrass, other grass species, cereal grain, corn, alfalfa, pastures, other crops, and Conservation Reserve Program (CRP) lands. Each SMA summary includes the total number of burn days and the justification for no-burn days.

Figure 5 shows the number of acres burned in northern Idaho SMAs for the last 3 years under the CRB program.

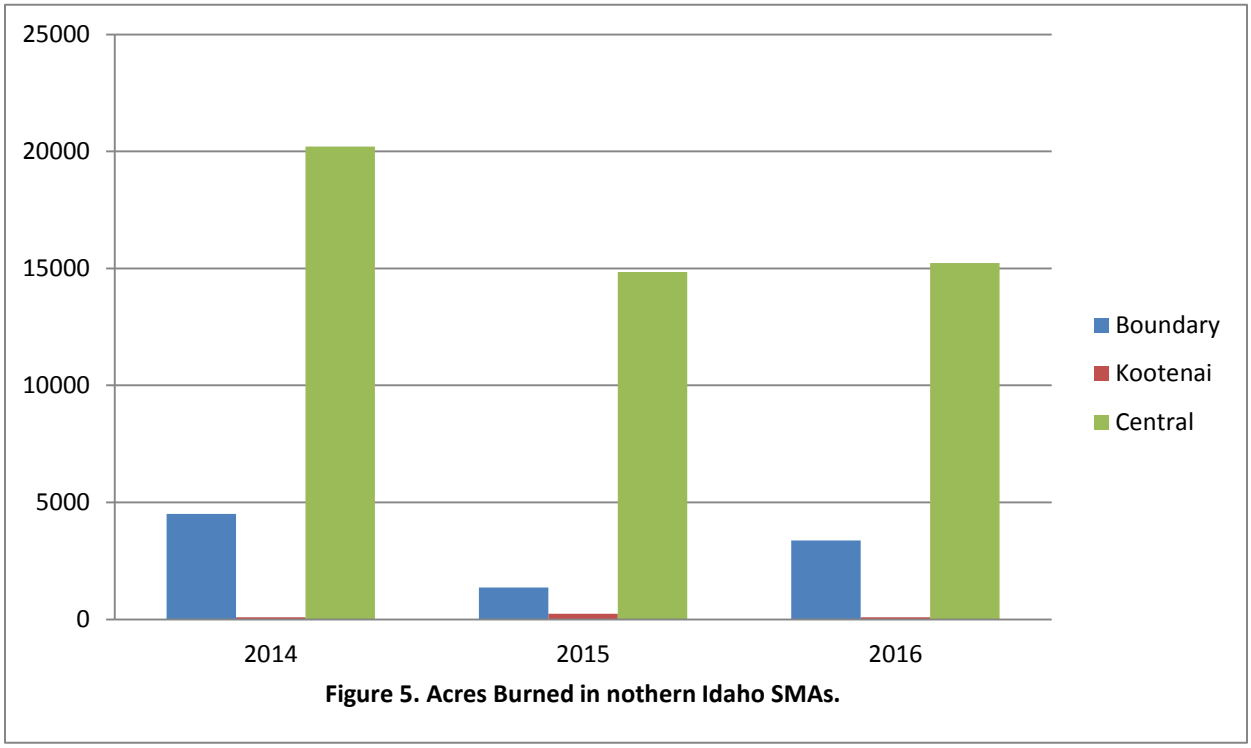

Figure 5. Acres burned in northern Idaho SMAs over 3 years.

Figure 6 shows the number of acres burned in southern Idaho SMAs for the last 3 years under the CRB program.

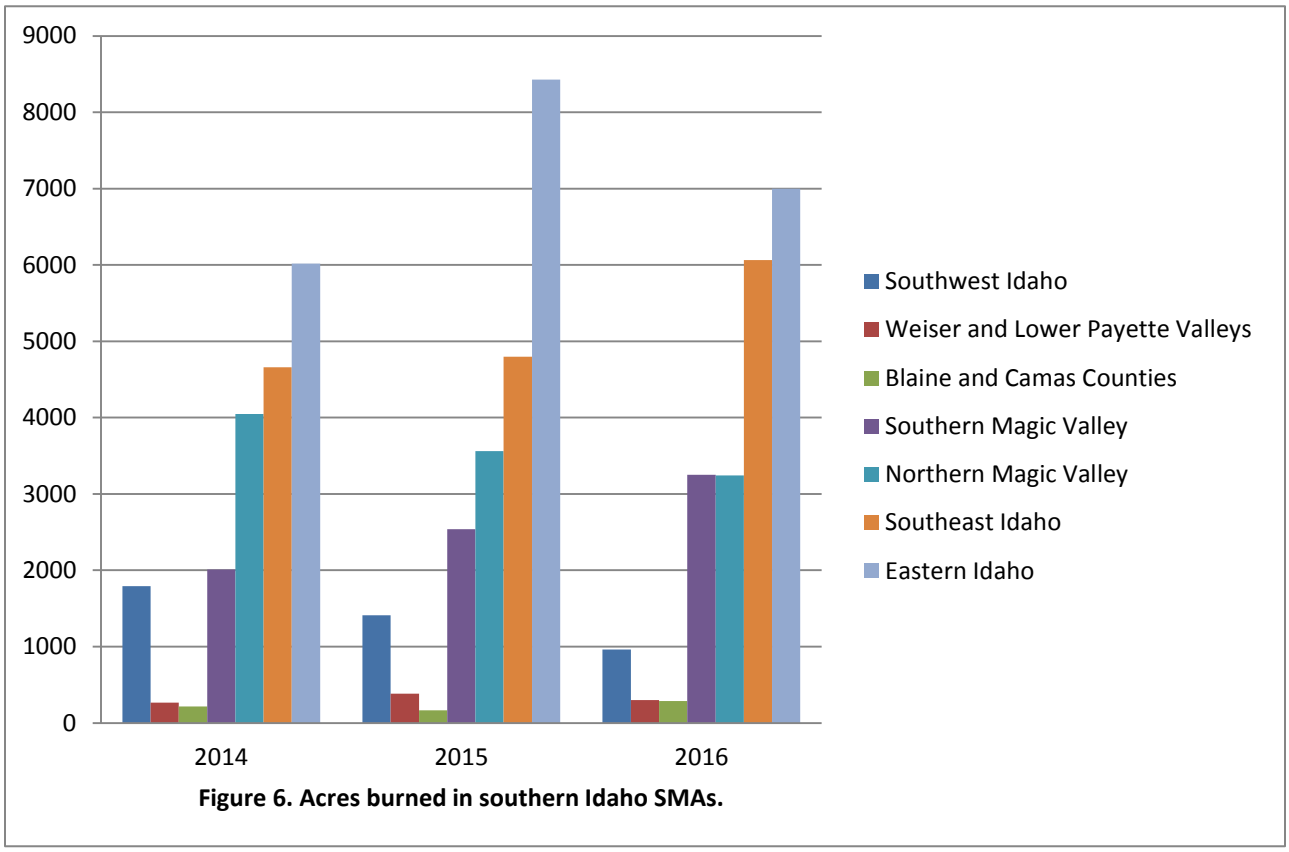

Figure 6. Acres burned in southern Idaho SMAs over 3 years.

4.6.1 Boundary County Smoke Management Area

The Boundary County SMA covers 1,278 square miles and includes all of Boundary County (Figure 1). The majority of the crop residue burning in Boundary County occurs in the Kootenai River valley along the river and adjacent benches.

The primary crop residue burned in the Boundary County SMA in 2016 was cereal grain stubble; however, residue from other crops, such as Kentucky bluegrass, legumes, and hops, has historically been burned as well. Peak burn months for this SMA are April–June and August–October. High relative humidity and high fuel moisture often limit burning in the early spring and late fall. Ventilation forecasting also plays a significant role in burn decisions for this area.

4.6.1.1 Acres Burned

Table 2 shows the acres burned in the spring and fall for each crop type during the 2014–2016 burn seasons. Figure 7 shows the locations of the 2016 burns in the SMA. In this SMA, 1,831 (54%) were burned within 3 miles of an ISP.

Table 2. Summary of acres burned in the Boundary County SMA.

Burn Season and Crop Type	Acres Burned		
	2014	**2015**	**2016**
Spring[a]			
Cereal grain	1,209	740	517
CRP	55	0	0
Other crops	0	0	0
Subtotal	1,264	740	517
Fall[b]			
Cereal grain	3,169	625	2,853
Other crops	70	0	0
Subtotal	3,239	624	2,853
Total	**4,503**	**1,365**	**3,370**

a. Spring season is January 1–June 30.
b. Fall season is July 1–December 31.
Note: CRP = Conservation Reserve Program lands

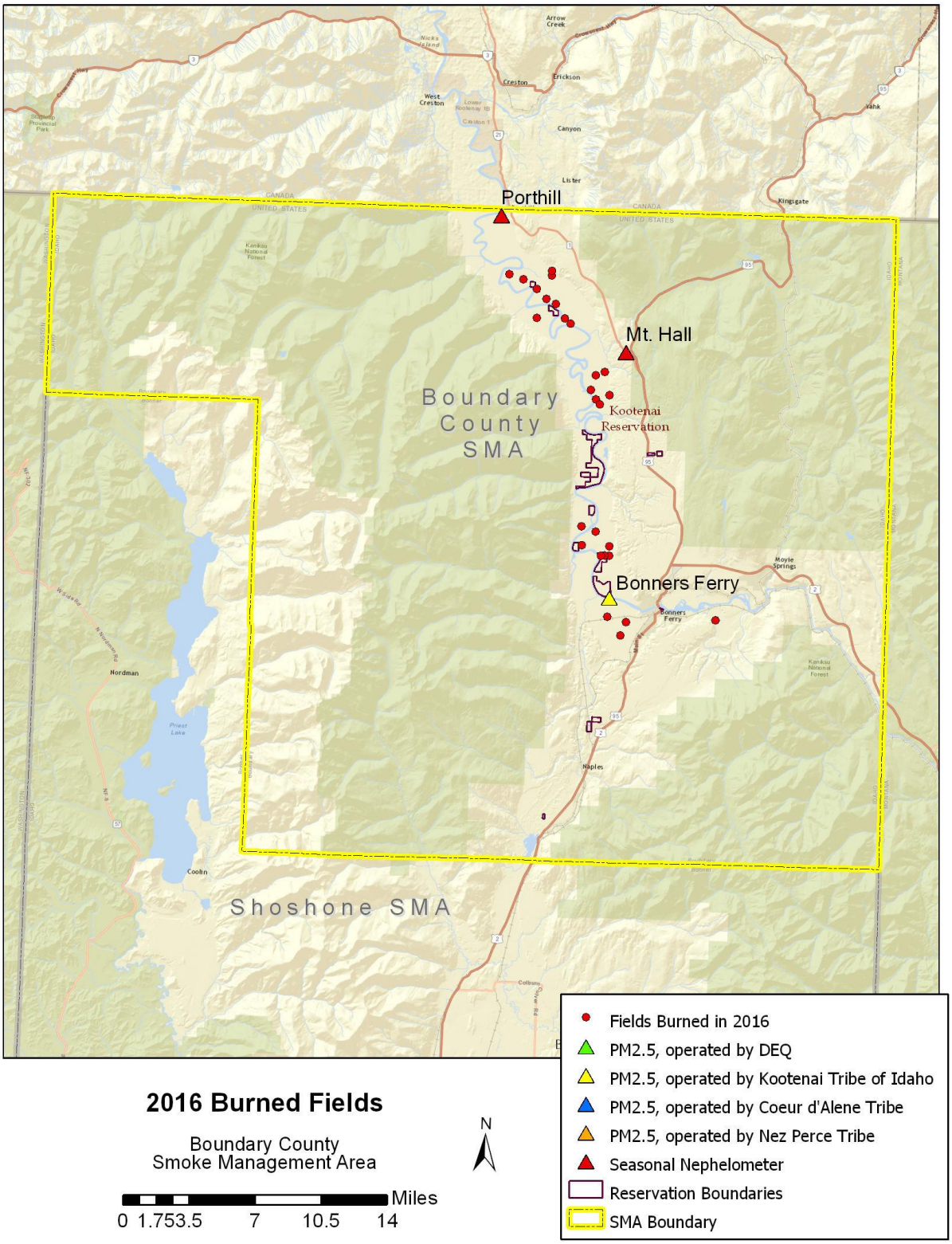

Figure 7. Locations of 2016 burns in the Boundary County SMA.

4.6.1.2 Daily Burn Decisions and Air Quality

DEQ field coordinators were on site in this SMA on many burn days and conditional burn days during August, September, and October to evaluate the suitability of the field and weather conditions for potential burning. Burn days were limited, and on many approved days, conditions were marginal and acreage limited. Table 3 shows the summary of 2016 burn decisions for the Boundary County SMA.

Table 3. Summary of burn decisions for the Boundary County SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days Due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Boundary	18	157	5	20	1	9	5

a. This summary includes all burn decisions issued for 2016. Burn decisions are provided weekdays throughout the year. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Boundary County SMA.

4.6.2 Kootenai County Smoke Management Area

The Kootenai County SMA covers 1,316 square miles and includes all of Kootenai County (Figure 1). Crop residue burning in the Kootenai County SMA is limited by urban development. The Rathdrum Prairie is bordered to the north by the city of Rathdrum, to the east by the city of Hayden, and to the south by the cities of Post Falls and Coeur d'Alene, and to the west by the Washington/Idaho state line. Rose Lake includes the Chain Lakes area that follows the Coeur d'Alene River from Cataldo as it flows into Coeur d'Alene Lake.

4.6.2.1 Acres Burned

Table 4 shows the acres burned in the fall for each crop type during the 2014–2016 burn seasons. Figure 8 shows the locations of the fields burned during 2016. In this SMA, there were no acres burned within 3 miles of an ISP.

Table 4. Summary of acres burned in the Kootenai County SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Fall[a]			
Kentucky bluegrass	0	0	0
Cereal grain	0	155	0
Other grass species	88	90	95
Total	**88**	**245**	**95**

a. Fall season is July 1–December 31.

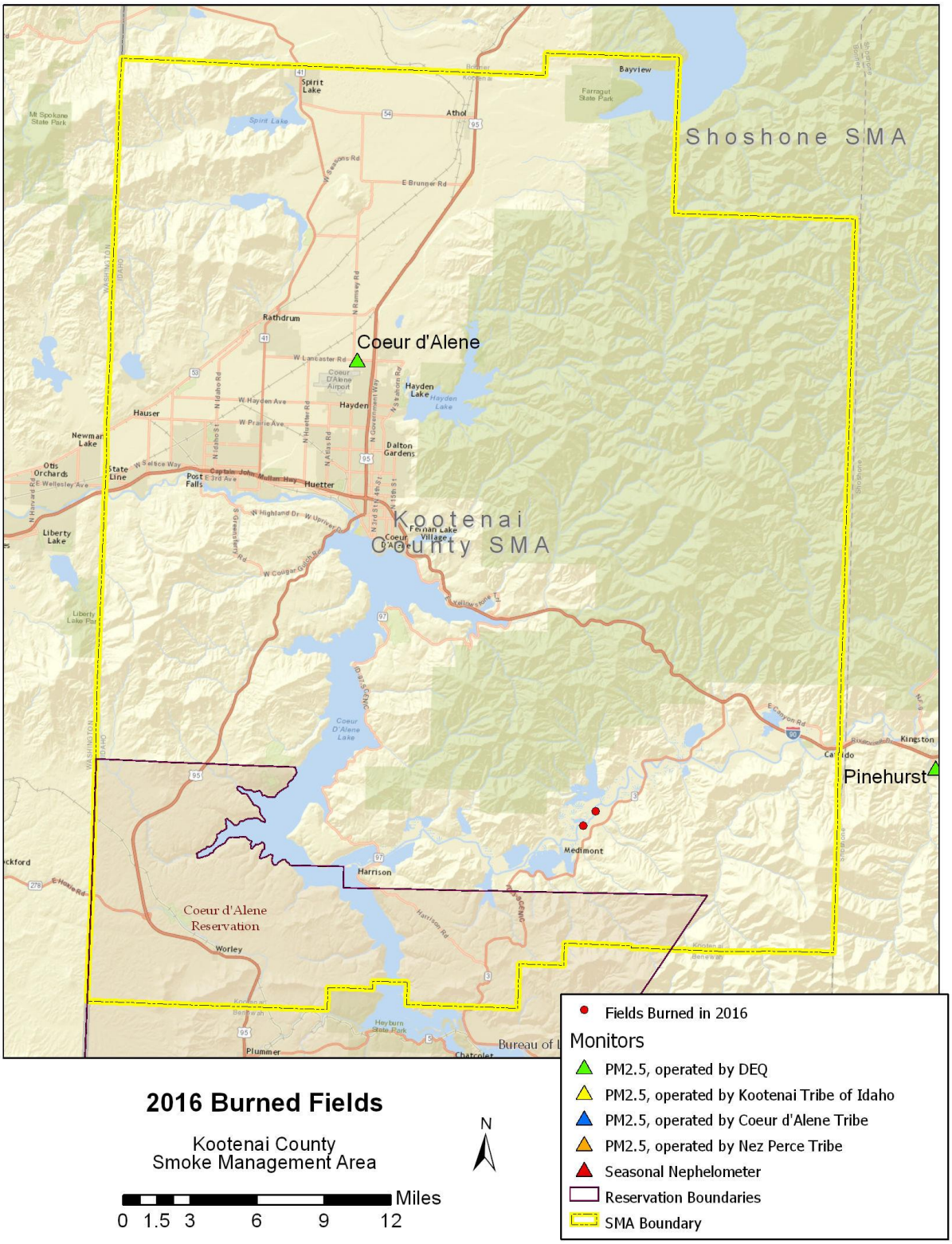

Figure 8. Locations of 2016 burns in the Kootenai County SMA.

4.6.2.2 Daily Burn Decisions and Air Quality

Table 5 shows the summary of 2016 burn decisions for the Kootenai County SMA.

Table 5. Summary of burn decisions for the Kootenai County SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days Due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Kootenai	1	203	3	0	0	0	3

a. This summary includes all burn decisions issued for 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Kootenai County SMA.

4.6.3 Central Smoke Management Area

The Central SMA covers 13,403 square miles and includes Latah, Nez Perce, Lewis, Idaho, and Clearwater Counties. Additionally, the Nez Perce Indian Reservation, which contains portions of each of these counties, is located entirely within this SMA (Figure 1). All burning within the reservation boundary is managed by the Nez Perce Tribe. Burning is mainly conducted in southwestern Clearwater, northwestern Idaho, northeastern Nez Perce, and Latah Counties.

The primary crop burned in the Central SMA is cereal grain stubble followed by Kentucky bluegrass. Peak burn months for this SMA are August through October.

4.6.3.1 Acres Burned

Table 6 shows the acres burned in the spring and fall for each crop type during the 2014–2016 burn seasons. Figure 9 shows the locations of fields burned during 2016. In this SMA, 3,984 (27%) acres burned were located within 3 miles of an ISP.

Table 6. Summary of acres burned in the Central SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Spring[a]			
CRP	378	293	317
Cereal grain	3,521	1,512	495
Kentucky Bluegrass	0	16	0
Pasture	0	42	0
Other grass	85	92	10
Other crops	150	29	3
Subtotal	4,134	1,984	825
Fall[b]			
CRP	859	401	2
Cereal grain	12,499	9,031	11,260
Kentucky bluegrass	1,092	1,607	1,435
Pasture	103	0	5
Other grass	1,310	1,752	1,435
Other crops	220	71	45
Subtotal	16,083	12,862	14,182
Total	**20,202**	**14,846**	**15,007**

a. Spring season is January 1–June 30.
b. Fall season is July 1–December 31.
Note: CRP = Conservation Reserve Program lands

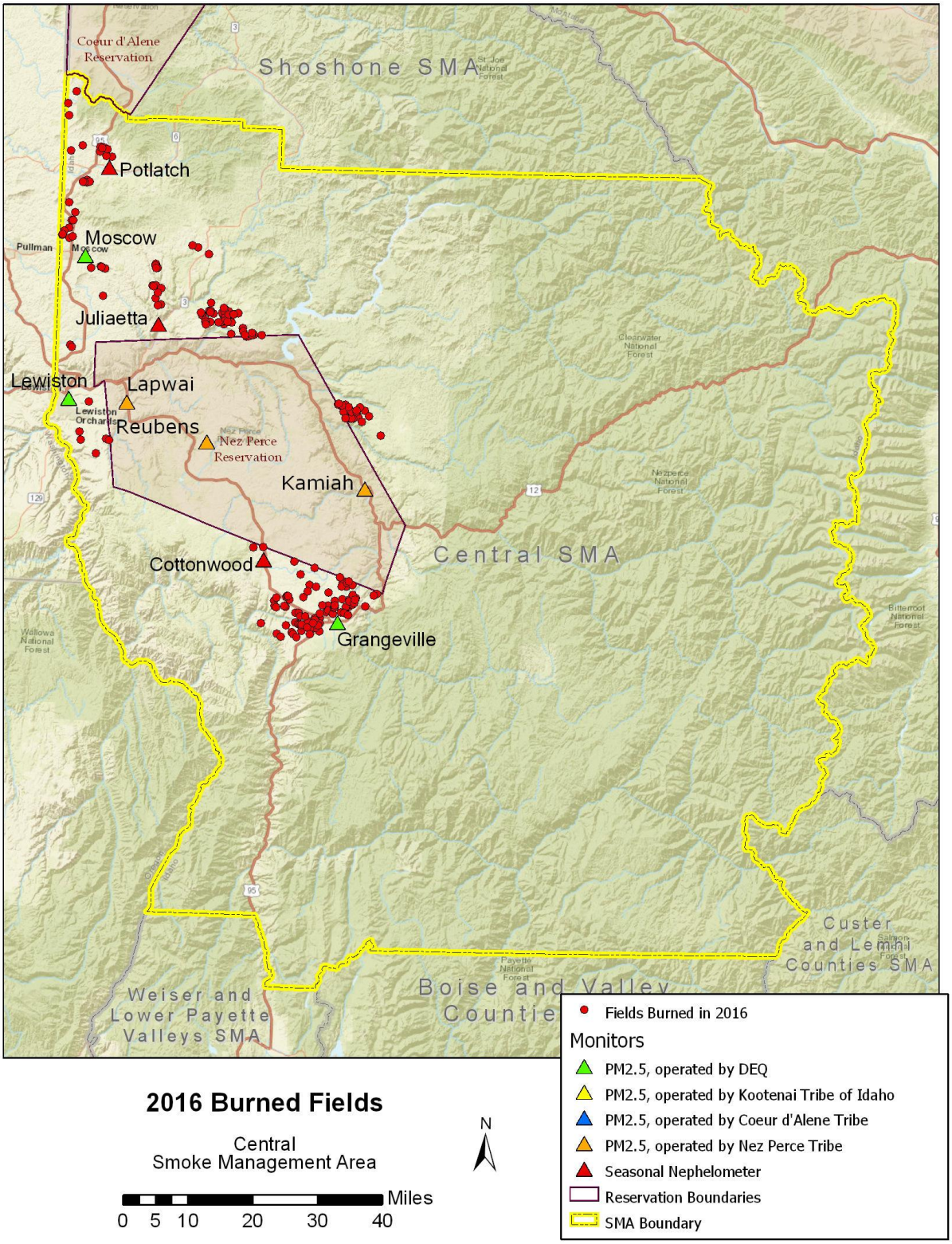

Figure 9. Locations of 2016 burns in the Central SMA.

4.6.3.2 Daily Burn Decisions and Air Quality

Table 7 shows the summary of 2016 burn decisions for each county in the Central SMA.

Table 7. Summary of burn decisions for the Central SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Clearwater	10	178	3	12	0	5	3
Idaho	18	142	4	28	4	9	8
Latah	22	141	5	29	2	7	9
Nez Perce	19	137	3	36	1	10	8

a. This summary includes all burn decisions issued for 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Central SMA.

4.6.4 Southwestern Idaho Smoke Management Area

The Southwestern Idaho SMA covers 12,462 square miles and includes Canyon, Ada, Owyhee, and Elmore Counties (Figure 1). Western Canyon County, northwestern Owyhee County, and southeastern Owyhee County account for the majority of acres burned (Snake River valley).

The primary crops burned included cereal grain stubble, pasture, and alfalfa residue. Burning may occur year-round, but the peak burn periods in this SMA are March–April and July–October. Two ambient air quality monitors that measure $PM_{2.5}$ are located in Nampa and Boise, and two ambient air quality monitors that measure ozone are located in Boise and Meridian.

4.6.4.1 Acres Burned

Table 8 shows the acres burned in the spring and fall for each crop type during the 2014-2016 burn seasons. Figure 10 shows the locations of fields burned during 2016. In this SMA, 613 (64%) acres burned were located within 3 miles of an ISP.

Table 8. Summary of acres burned in the Southwestern Idaho SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Spring[a]			
Alfalfa	19	0	0
Cereal grain	16	0	40
Corn	0	20	0
Other crops	63	25	6
Subtotal	79	45	46
Fall[b]			
Alfalfa	207	321	286
Cereal grain	1,508	1,033	570
CRP	0	0	0
Other crops	0	5	6
Pasture	0	6	0
Subtotal	1,715	1,365	916
Total	**1,794**	**1,410**	**962**

a. Spring season is January 1–June 30.
b. Fall season is July 1–December 31.
Note: CRP = Conservation Reserve Program lands

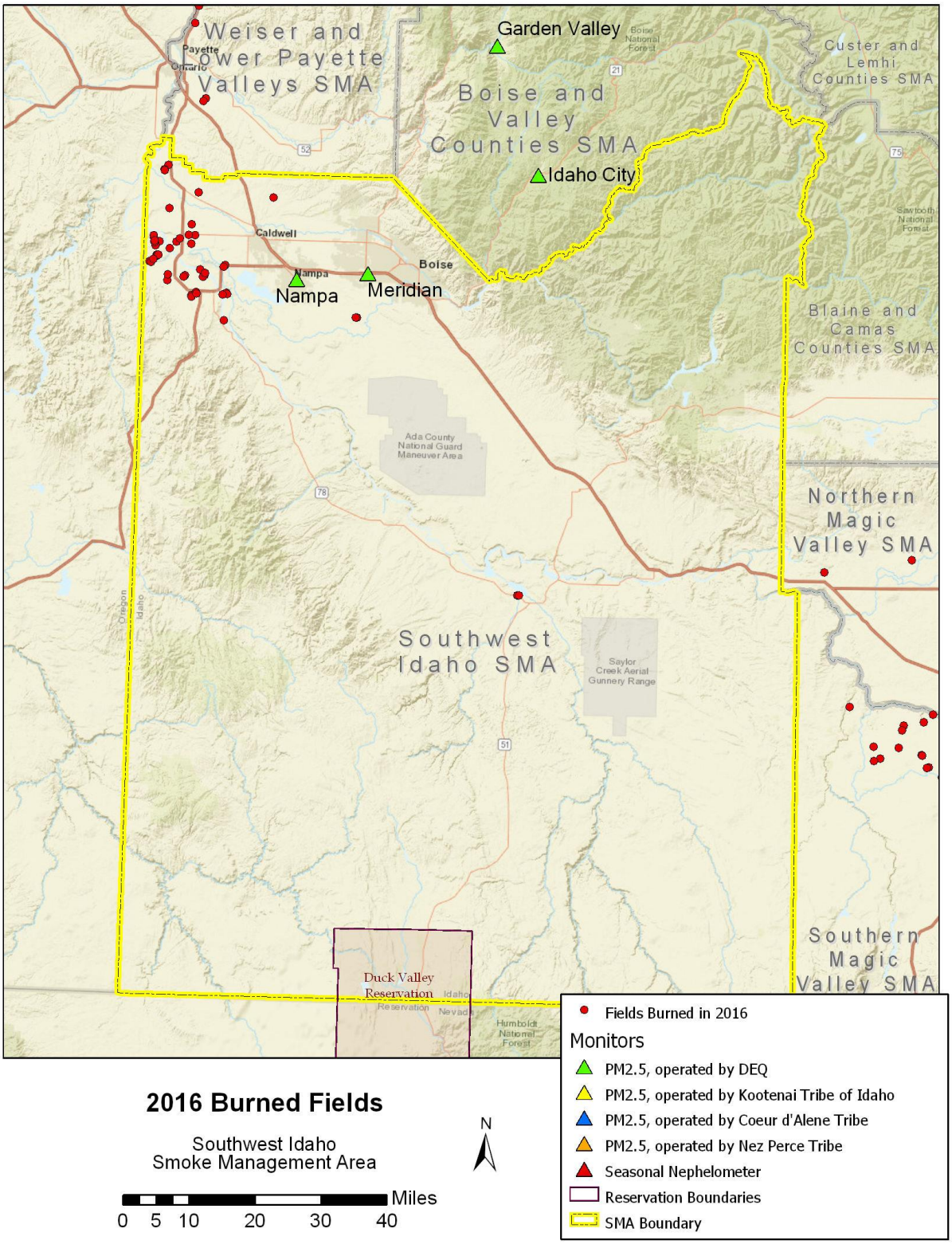

Figure 10. Locations of 2016 burns in the Southwestern Idaho SMA.

4.6.4.2 Daily Burn Decisions and Air Quality

Table 9 shows the summary of 2016 burn decisions for each county in the Southwestern Idaho SMA.

Table 9. Summary of burn decisions for the Southwestern Idaho SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days Due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Ada	2	211	0	0	0	1	5
Canyon	5	186	2	2	3	7	5
Elmore	1	213	0	0	0	0	5
Owyhee	16	182	8	1	3	1	9

a. This summary includes all burn decisions issued through December 31, 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Southwestern Idaho SMA.

4.6.5 Weiser and Lower Payette Valleys Smoke Management Area

The Weiser and Lower Payette Valleys SMA covers 3,820 square miles and includes Adams, Washington, Payette, and Gem Counties (Figure 1). Payette and Washington Counties account for the majority of acres burned.

The primary crops burned in the SMA are cereal grain stubble and pasture. Burning may occur year-round, but the peak burn periods are March–April and July–October.

4.6.5.1 Acres Burned

Table 10 shows the acres burned in the spring and fall for each crop type during the 2014–2016 burn seasons. Figure 11 shows the locations of fields burned during 2016. In this SMA, 182 (61%) acres burned were located within 3 miles of an ISP.

Table 10. Summary of acres burned in the Weiser and Lower Payette Valleys SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Spring[a]			
Cereal grain	0	0	0
Corn	28	270	0
Other crops	52	34	34
Subtotal	80	304	34
Fall[b]			
Cereal grain	157	15	64
Corn	21	0	137
Alfalfa	8	65	65
Subtotal	186	80	266
Total	**266**	**384**	**300**

a. Spring season is January 1–June 30.
b. Fall season is July 1–December 31.

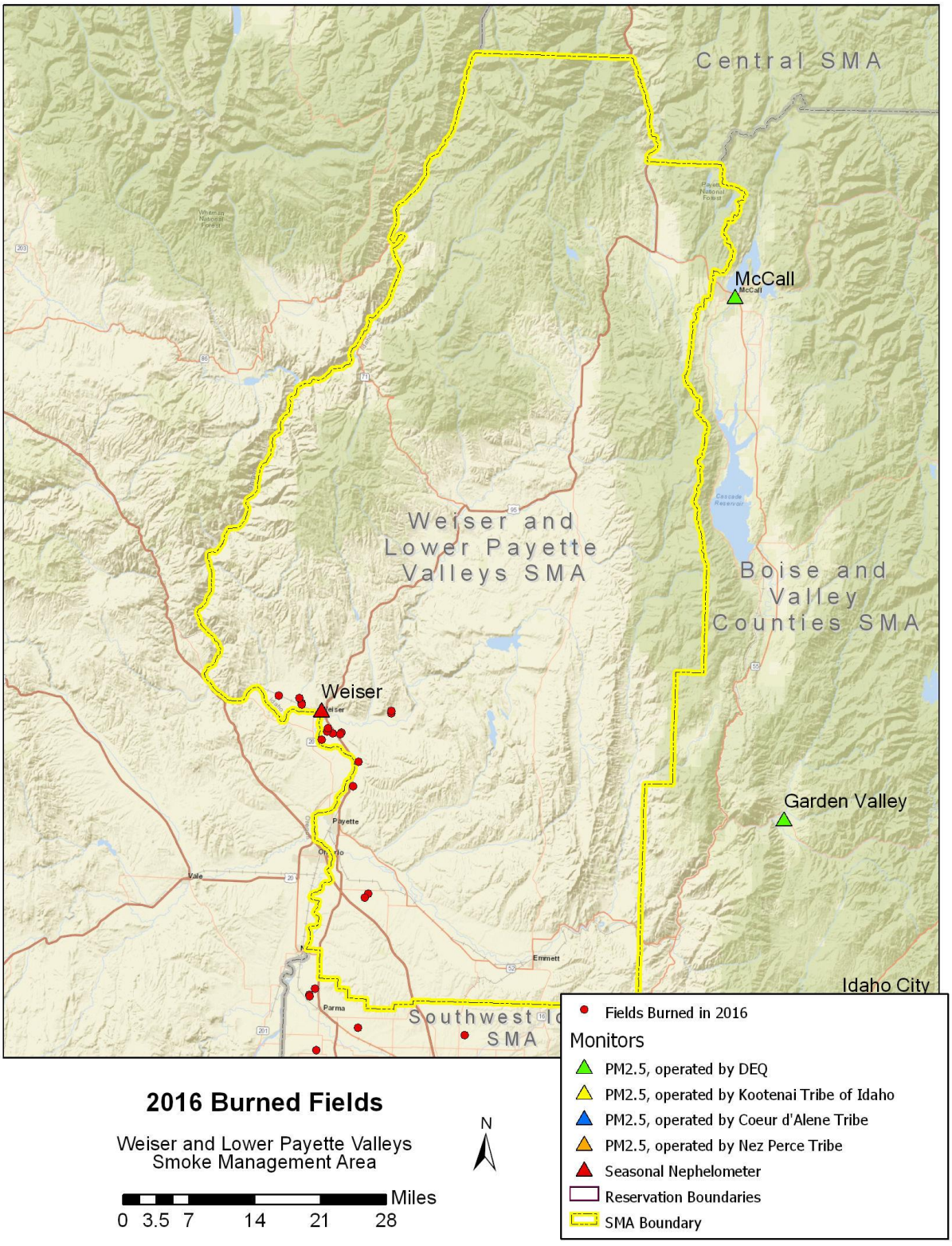

Figure 11. Locations of 2016 burns in the Weiser and Lower Payette Valleys SMA.

4.6.5.2 Daily Burn Decisions and Air Quality

Table 11 shows the summary of 2016 burn decisions for each county in the Weiser and Lower Payette Valleys SMA.

Table 11. Summary of burn decisions for the Weiser and Lower Payette Valleys SMA.

County	Approved Burn Days	Days With No Requests to Burn[a]	No-Burn Days Due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Adams	0	214	0	0	0	0	5
Gem	0	214	0	0	0	0	5
Payette	4	210	0	0	0	0	5
Washington	9	198	0	2	2	3	6

a. This summary includes all burn decisions issued through December 31, 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Weiser and Lower Payette Valleys SMA.

4.6.6 Blaine and Camas Counties Smoke Management Area

The Blaine and Camas Counties SMA covers 3,740 square miles and includes Blaine and Camas Counties (Figure 1). The SMA includes high-elevation prairie, foothills, and mountains. Blaine County accounts for the majority of acres burned. Burning may occur year-round, but the typical burn season is fall.

4.6.6.1 Acres Burned

Table 12 shows the acres burned in the fall for each crop type during the 2014–2016 burn seasons. No acres were burned in spring 2016. Figure 12 shows the locations of the fields burned during 2016. In this SMA, all acres burned (100%) were located within 3 miles of an ISP.

Table 12. Summary of acres burned in the Blaine and Camas Counties SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Fall[a]			
Cereal grain	217	165	289
Other crops	0	0	0
Total	**217**	**165**	**289**

a. Fall season is July 1–December 31.

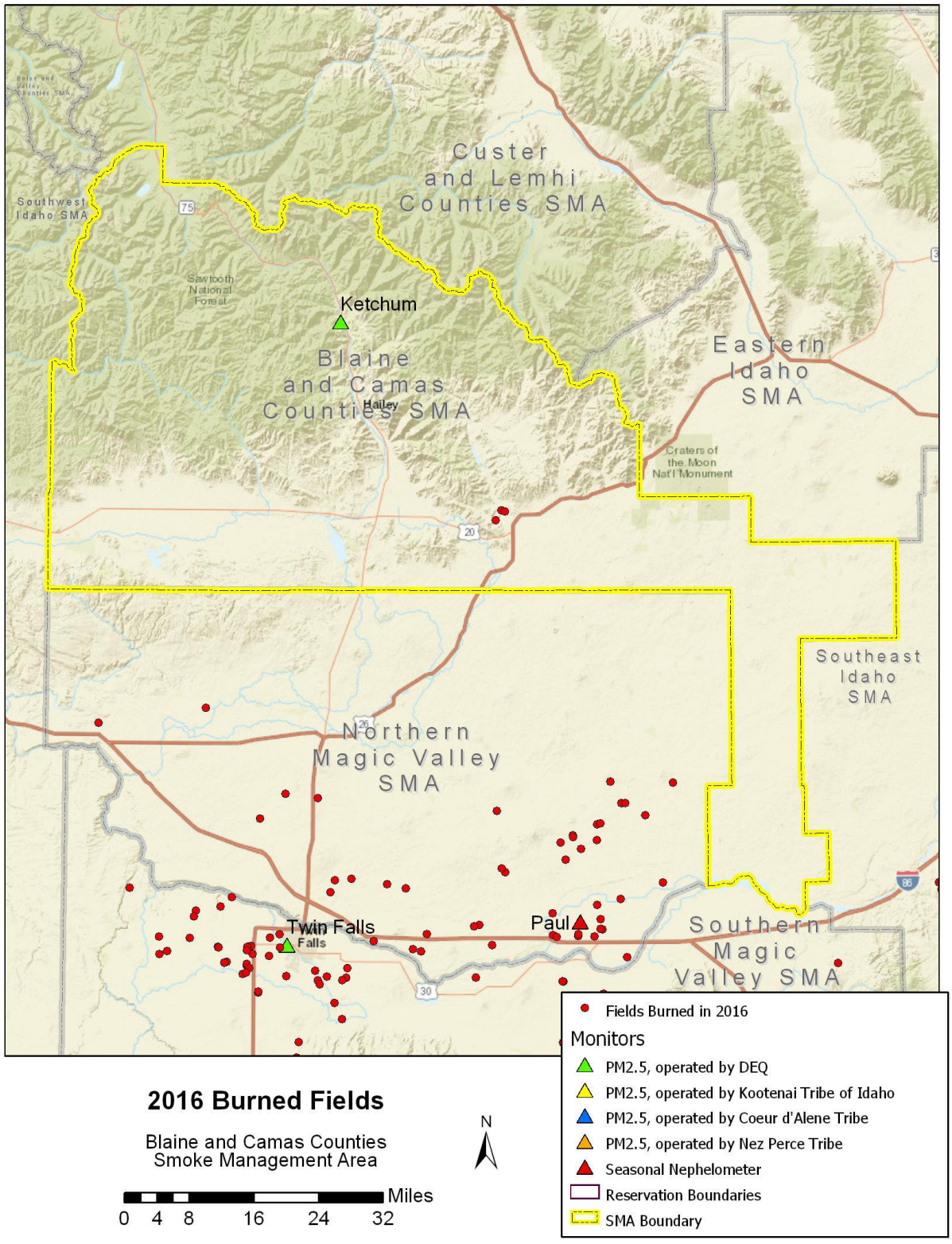

Figure 12. Locations of 2016 burns in the Blaine and Camas Counties SMA.

4.6.6.2 Daily Burn Decisions and Air Quality

Table 13 shows the summary of 2016 burn decisions for the two counties in this SMA.

Table 13. Summary of burn decisions for the Blaine and Camas Counties SMA.

County	Approved Burn Days	Days With No Requests to Burn[a]	No-Burn Days Due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Blaine	2	205	5	0	2	0	6
Camas	0	213	1	0	0	0	5

a. This summary includes all burn decisions issued through December 31, 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Blaine and Camas Counties SMA.

4.6.7 Southern Magic Valley Smoke Management Area

The Southern Magic Valley SMA covers 4,508 square miles and includes Twin Falls and Cassia Counties (Figure 1). The topography of the area includes mountains and valleys in the south and the Snake River valley in the north.

The primary crop burned has generally been cereal grain stubble. Burning may occur year-round, but the peak burn periods are March–May and July–October.

4.6.7.1 Acres Burned

Table 14 shows the acres burned in the spring and fall for each crop type during the 2014–2016 burn seasons. Figure 13 shows the locations of fields burned during 2016. In this SMA, 957 (30%) acres burned were located within 3 miles of an ISP.

Table 14. Summary of acres burned in the Southern Magic Valley SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Spring[a]			
Legumes	0	0	16
Corn	16	49	121
Cereal grain	585	358	331
Other crops	17	0	0
Subtotal	618	407	468
Fall[b]			
CRP	280	0	60
Legumes	0	0	18
Cereal grain	1,079	2,133	2,705
Other crops	33	0	0
Subtotal	1,392	2,133	2,783
Total	**2,010**	**2,540**	**3,251**

a. Spring season is January–June 30.
b. Fall season is July 1–December 31.
Note: CRP = Conservation Reserve Program lands

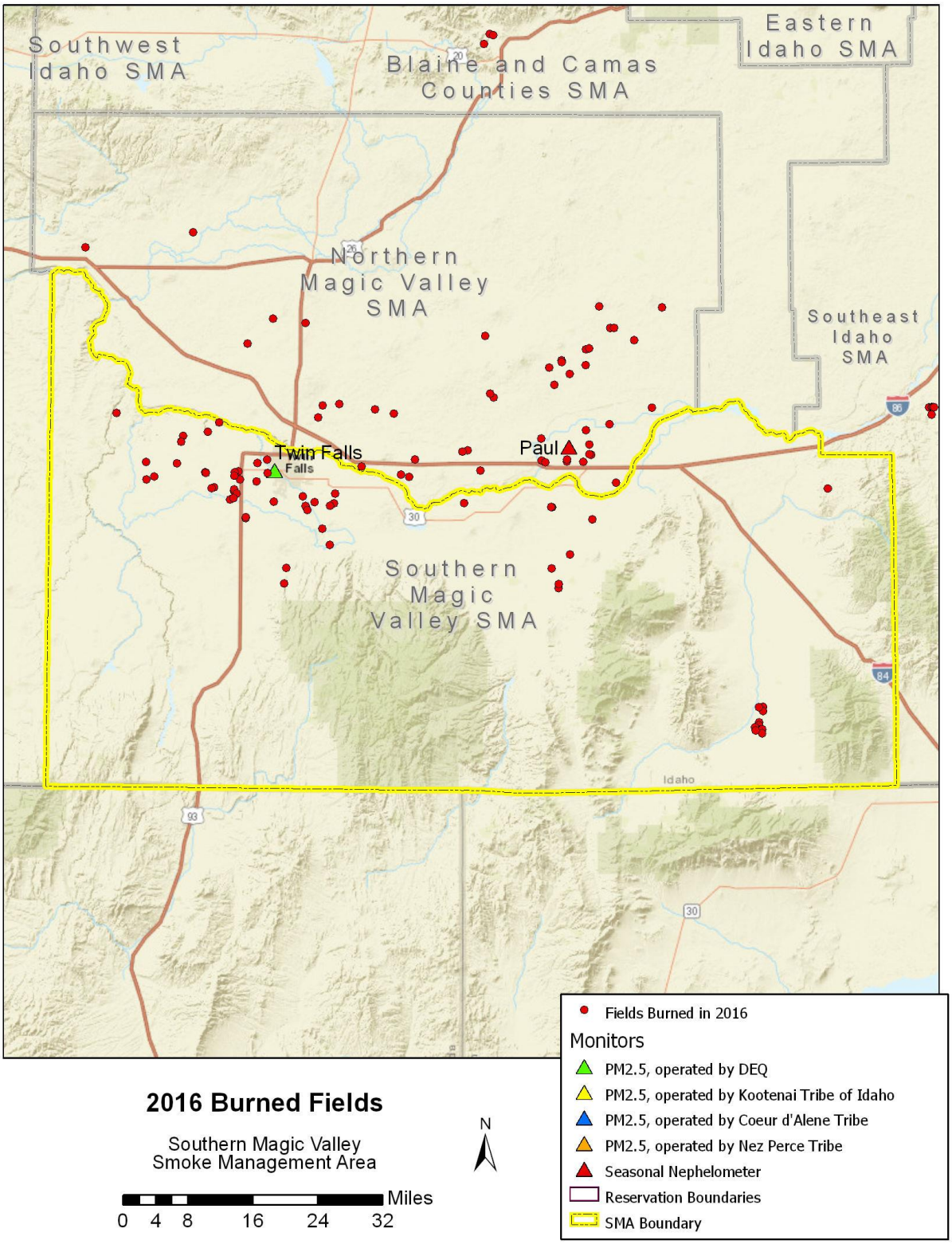

Figure 13. Locations of 2016 burns in the Southern Magic Valley SMA.

4.6.7.2 Daily Burn Decisions and Air Quality

Table 15 shows the summary of 2016 burn decisions for the two counties in the Southern Magic Valley SMA.

Table 15. Summary of burn decisions for the Southern Magic Valley SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days Due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Cassia	7	199	3	0	4	0	7
Twin Falls	32	131	6	25	14	4	10

a. This summary includes all burn decisions issued through December 31, 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Southern Magic Valley SMA.

4.6.8 Northern Magic Valley Smoke Management Area

The Northern Magic Valley SMA covers 3,305 square miles and includes Gooding, Lincoln, Jerome, and Minidoka Counties (Figure 1). The topography of the area is dominated by the Snake River valley in the south, foothills in the north, and lava beds in the northeast.

The primary crop burned has generally been cereal grain stubble. Burning may occur year-round, but the peak burn periods are March–April and July–October.

4.6.8.1 Acres Burned

Table 16 shows the acres burned in the spring and fall for each crop type during the 2014–2016 burn seasons. Figure 14 shows the locations of fields burned during 2016. In this SMA, 856 (24%) acres burned were located within 3 miles of an ISP.

Table 16. Summary of acres burned in the Northern Magic Valley SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Spring[a]			
Pasture	0	0	3
Cereal grain	416	115	0
Other crops	0	0	0
Subtotal	416	115	3
Fall[b]			
Alfalfa	74	0	0
CRP	0	0	17
Cereal grain	3,588	3,448	3,208
Other crops	1	0	0
Corn	0	0	15
Subtotal	3,633	3,448	3,240
Total	**4,049**	**3,363**	**3,243**

a. Spring season is January 1–June 30.
b. Fall season is July 1–December 31.
Note: CRP = Conservation Reserve Program lands

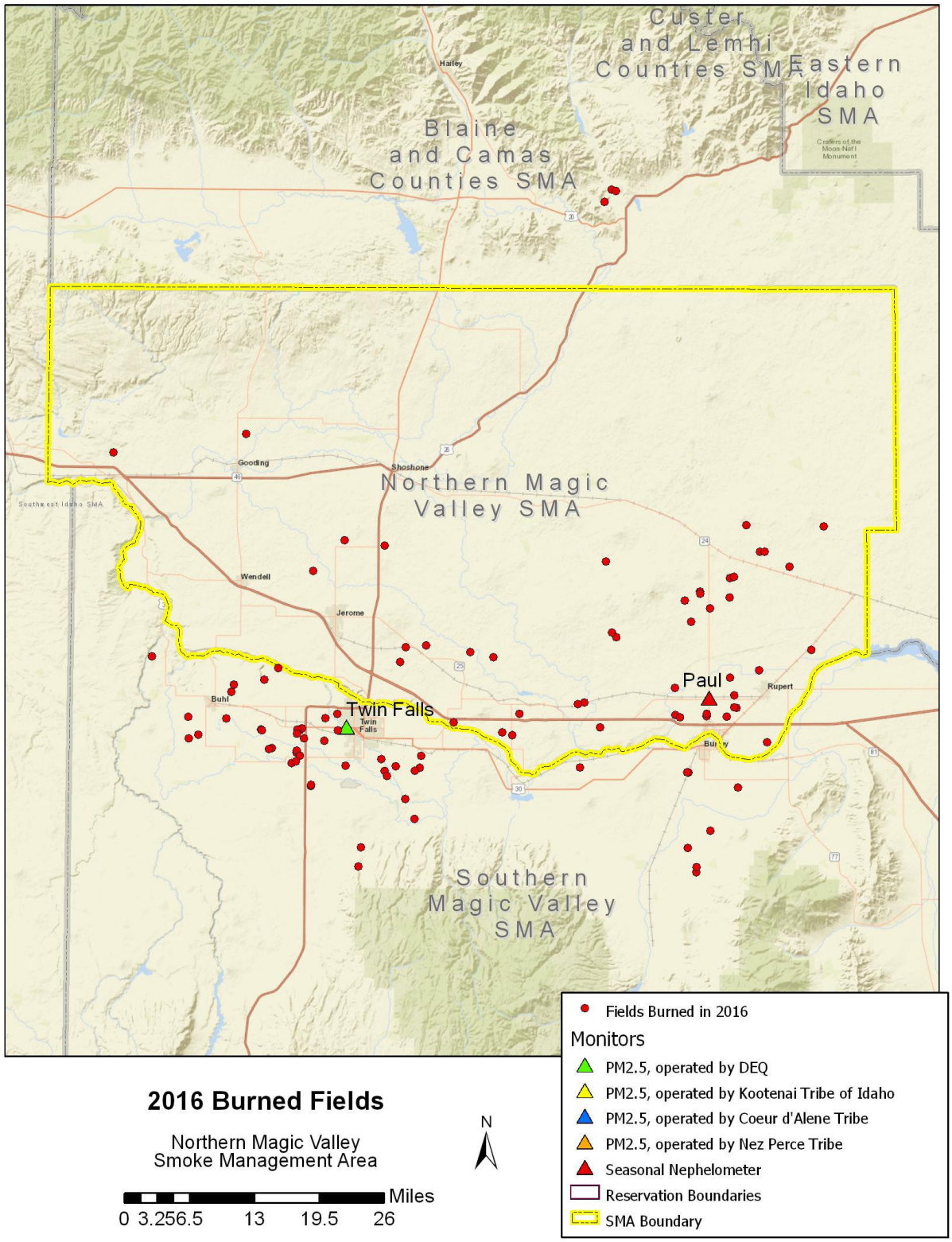

Figure 14. Locations of 2016 burns in the Northern Magic Valley SMA.

4.6.8.2 Daily Burn Decisions and Air Quality

Table 17 shows the summary of 2016 burn decisions for each county in the Northern Magic Valley SMA.

Table 17. Summary of burn decisions for the Northern Magic Valley SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Gooding	2	212	0	0	0	0	5
Jerome	12	186	4	2	4	4	8
Lincoln	2	211	0	0	1	0	5
Minidoka	20	173	4	4	5	5	10

a. This summary includes all burn decisions issued through December 31, 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Northern Magic Valley SMA.

4.6.9 Southeastern Idaho Smoke Management Area

The Southeastern Idaho SMA covers 9,428 square miles and includes Bingham, Power, Bannock, Caribou, Oneida, Franklin, and Bear Lake Counties (Figure 1). The area is topographically complex with the exception of the relatively flat lowlands of the Snake River Plain. The mountainous terrain, with its ridges and valleys, can strongly influence wind-flow patterns and affect smoke dispersion.

The primary crops burned have generally been cereal grain stubble and CRP lands. Burning may occur year-round, but the peak burn periods in the SMA are April–May and July–October.

4.6.9.1 Acres Burned

Table 18 shows the acres burned in the spring and fall for each crop type during the 2014–2016 burn seasons. Figure 15 shows the locations of fields burned during 2016. In this SMA, 1,090 (18%) acres burned were located within 3 miles of an ISP.

Table 18. Summary of acres burned in the Southeastern Idaho SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Spring[a]			
CRP	460	5	0
Cereal grain	1,263	72	1,274
Pasture	36	51	2
Other crops	0	5	6
Subtotal	1,759	133	1,282
Fall[b]			
CRP	633	18	630
Cereal grain	2,269	4,610	4,132
Other crops	0	6	5
Pasture	0	30	0
Alfalfa	0	0	15
Subtotal	2,902	4,664	4,782
Total	**4,661**	**4,797**	**6,064**

a. Spring season is January 1–June 30.
b. Fall season is July 1–December 31.
Note: CRP = Conservation Reserve Program lands

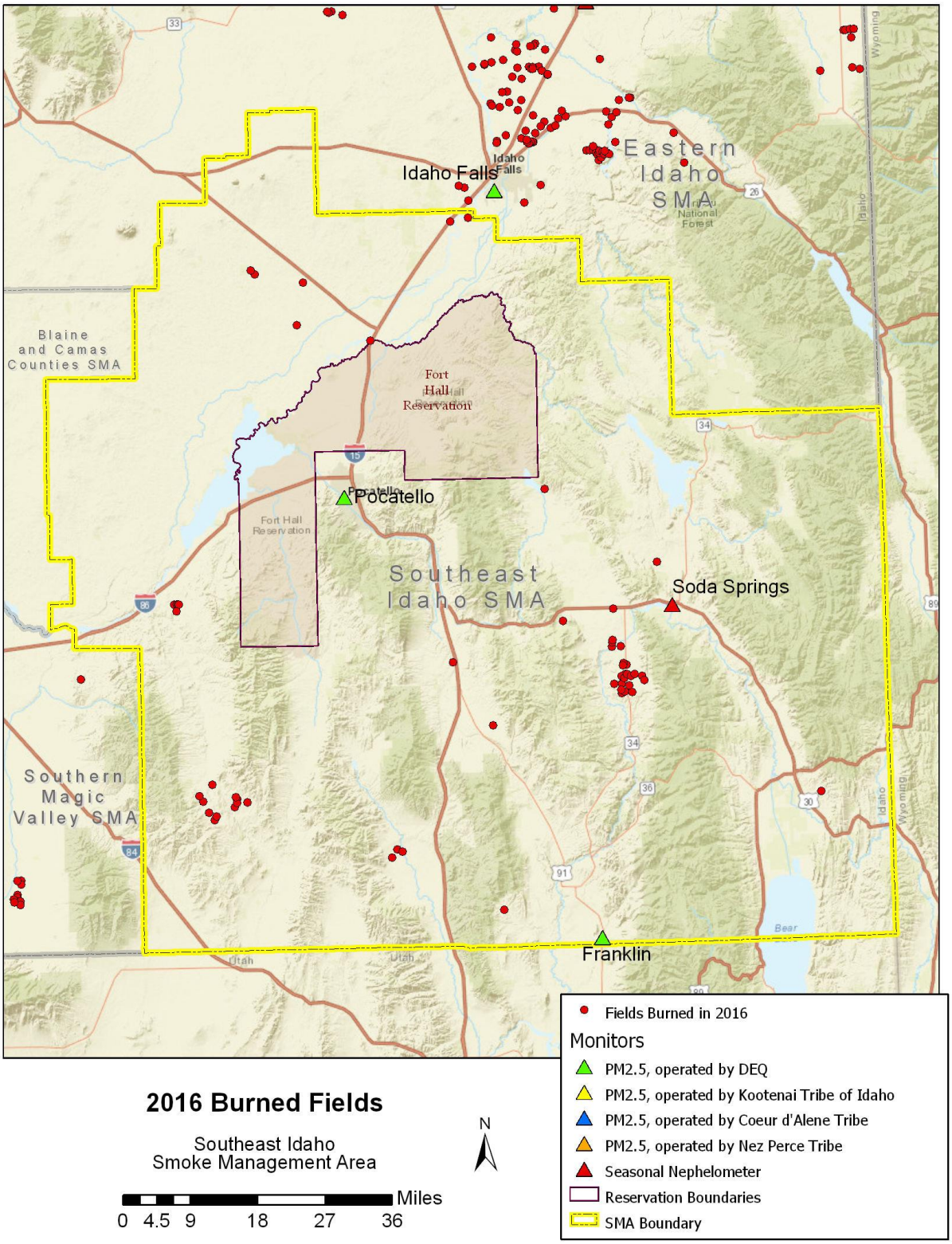

Figure 15. Locations of 2016 burns in the Southeastern Idaho SMA.

4.6.9.2 Daily Burn Decisions and Air Quality

Table 19 shows the summary of 2016 burn decisions for each county in the Southeastern Idaho SMA.

Table 19. Summary of burn decisions for the Southeastern Idaho SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Bannock	5	192	1	13	5	0	7
Bear Lake	1	213	0	0	0	0	5
Bingham	6	190	1	10	7	4	5
Caribou	24	169	1	16	3	0	7
Franklin	1	213	0	0	0	0	5
Oneida	18	175	1	18	4	1	5
Power	5	209	0	0	0	0	5

a. This summary includes all burn decisions issued through December 31, 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Southeastern Idaho SMA.

4.6.10 Eastern Idaho Smoke Management Area

The Eastern Idaho SMA covers 9,826 square miles and includes Clark, Fremont, Butte, Jefferson, Madison, Teton, and Bonneville Counties (Figure 1). The topography of the area consists of mountains and valleys to the west, north, and east. The large central area of the SMA consists of the Snake River Plain and is relatively flat.

The primary crops burned were cereal grain stubble and CRP lands. Burning may occur year-round, but the peak burn periods are April–May and August–October.

4.6.10.1 Acres Burned

Table 20 shows the acres burned in the spring and fall for each crop type during the 2014–2016 burn seasons. Figure 16 shows the locations of fields burned during 2016. In this SMA, 2,479 (35%) acres burned were located within 3 miles of an ISP.

Table 20. Summary of acres burned in the Eastern Idaho SMA.

Burn Season and Crop Type	Acres Burned		
	2014	2015	2016
Spring[a]			
CRP	112	0	1,564
Cereal grain	245	1,566	134
Other crops	0	229	0
Pasture	0	2	5
Subtotal	357	1,797	1,703
Fall[b]			
CRP	0	511	375
Cereal grain	5,659	6,118	4,831
Other crops	0	0	90
Subtotal	5,659	6,629	5,296
Total	**6,016**	**8,426**	**6,999**

a. Spring season is January 1–June 30.
b. Fall season is July 1–December 31.
Note: CRP = Conservation Reserve Program lands

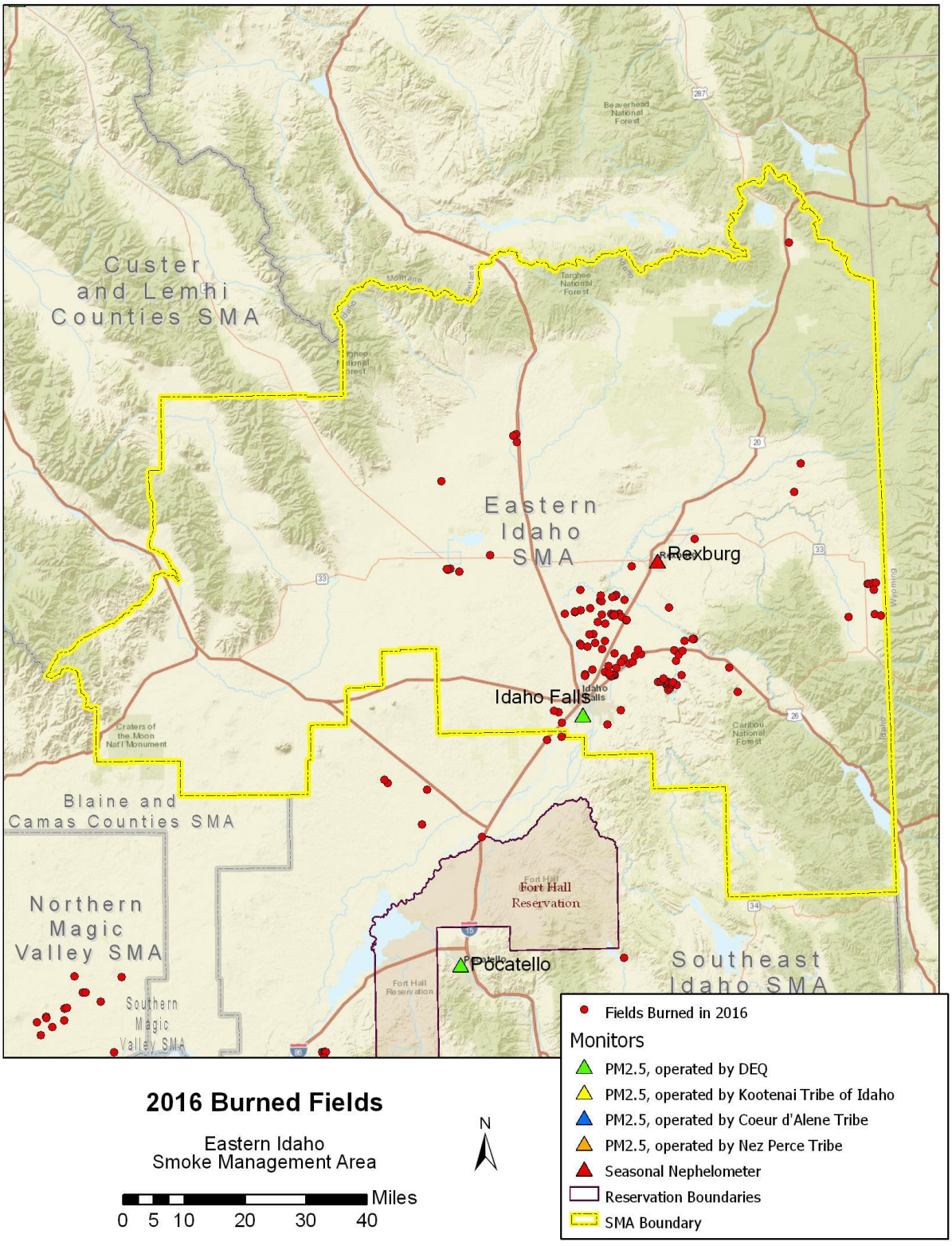

Figure 16. Locations of 2016 burns in the Eastern Idaho SMA.

4.6.10.2 Daily Burn Decisions and Air Quality

Table 21 shows the summary of 2016 burn decisions for each county in the Eastern Idaho SMA.

Table 21. Summary of burn decisions for the Eastern Idaho SMA.

County	Approved Burn Days	Days with No Requests to Burn[a]	No-Burn Days Due to Air Quality	No-Burn Days Due to Meteorological Conditions			No-Burn Days Due to Other Reasons[b]
				Fuel Moisture	Wind	Ventilation	
Butte	0	214	0	0	0	0	5
Clark	3	211	0	0	0	0	5
Fremont	6	199	0	8	0	2	5
Jefferson	20	158	6	18	13	4	9
Madison	3	204	0	8	4	0	5
Bonneville	24	155	6	19	11	3	10
Teton	7	198	0	8	4	0	5

a. This summary includes all burn decisions issued through December 31, 2016. The majority of the no-burn decisions due to no requests occurred outside the typical burn seasons (i.e., summer and winter).
b. Other reasons include National Weather Service-issued red-flag warnings and holidays.

0 contains an inventory of the acres burned for each SMA, including the Eastern Idaho SMA.

5. CRB Advisory Committee Recommendations

The Committee made no formal recommendations for program changes this year; however several program enhancements were suggested by the committee members. The following enhancements will be pursued in 2017:

- Increase the number of acres on good burn days and allow growers (especially in Boundary) to burn more if the conditions are going well.
  DEQ Response: DEQ will continue to provide flexibility to in-field coordinators for increasing acreage if conditions warrant. Identifying additional fields available to burn for each day prior to deployment may help improve efficiencies. The program's flexibility for burning additional acreage will be highlighted and encouraged during the annual coordinator training and throughout the season.

- Send email reminders for growers that have trainings that are about to expire.
  DEQ Response: DEQ will work with our IT group to include a function in the CRB database to report out growers and e-mail addresses for those who need training within a reasonable timeframe.

- Create an Advisory Committee Member pack. This packet should include; a history of the program, what the board does, and minutes from the last meeting.
  DEQ Response: DEQ will work to develop additional material that will accommodate this request. DEQ will target August 2017 for an initial product to coincide with potential new members joining.

- Focus on working with Highway districts in more areas of the state to get a roadway safety permit process going.
  DEQ Response: DEQ will begin by working with ITD regional contacts that have been helpful in the past to help coordinate outreach to other ITD and local highway districts in order to address potential roadway safety needs. A possible "boiler plate" type right of way agreement will be pursued.

- Include the names of the ISP's on the permits or add language on the grower page to get growers to look at and identify the ISP's within 3 miles of their fields is accurate.
  DEQ Response DEQ will work with our IT group to determine if this can be accomplished with the current resources available. The current permit identifies ISPs and types that are within 3-miles but does not provide the names of these institutions.

6. Conclusions

DEQ continues to operate the CRB program under the rules, guidelines, and procedures designed to protect public health. These procedures continue to achieve the program's purposes while providing for the use of fire as a tool to manage crop residue disposal in the State of Idaho. DEQ's evaluation of the program's effectiveness in meeting these goals in 2016 revealed that our focus on education and communication of program limitations, meteorological considerations, and coordination with all airshed users should continue to be a program focus.

This 2016 burn season evaluation identified several instances where DEQ approved crop residue burning likely contributed to measured air pollutant concentrations exceeding program defined post burn concentration thresholds. Based on evaluation of the meteorology, timing of burns, and field locations, DEQ approved crop residue burning likely contributed to these impacts. Although no health concerns were reported resulting from approved crop residue burning this year it did reveal additional coordination efforts with other airshed users may be necessary for future burn days.

The 2016 burn season was influenced by a hot and very dry summer followed by periodic wetting rains during early fall. This is a fairly common pattern for Idaho. Wildfire smoke impacts across central Idaho caused some limitations for crop residue burning in 2016. Wildfire smoke impacts are not an uncommon occurrence in Idaho during the summer months. Other impacts included: record breaking precipitation in October which reduced late season opportunities for burning in the north Idaho areas and numerous burn bans put into effect by local fire protection groups affected southeast Idaho burning opportunities in the summer months.

Annual total residue burning acreage for 2016 was 39,578. This is only slightly higher than 2015 total acreage of 37,462 but well under our program maximum of 67,416 in 2012. In 2012 there were a large number of CRP acres which may account for some of the increase acreage.

DEQ works hard every year to improve our understanding of the complex weather, fuel, and ignition systems which influence smoke management program decisions. DEQ enjoys working

with the regulated community and several concerned citizen groups to continually improve the program to achieve positive outcomes.

Appendix A. Meteorological Summary for Fall Burn Season

ANNUAL WEATHER SUMMARY FOR THE SMOKE DISPERSION FORECAST FALL SEASON FOR NORTHERN IDAHO, 2016

Operations:

The 2016 Agricultural Field Burning Smoke Management program for Northern Idaho began on August 1st with full operational forecasts. Idaho Department of Environmental Quality (IDEQ) manages the Crop Residue Burning (CRB) program for portions of southern Idaho and portions of northern Idaho. Smoke dispersion forecasts were e-mailed to IDEQ recipients by 8:00 AM PDT each day of the forecast season. The delivery of forecasts via e-mail was followed by conference calls at 8:30 am PDT each day. The morning conference calls were used to discuss the weather forecast for the "burn day" (i.e. today). A brief review of the previous day's activity and results was completed prior to the weather forecast discussion on the morning call.

A northern Idaho pre-season training and meeting occurred this year in Moscow from June 1st and 2nd. This meeting included burn program staff from several governmental agencies around the NW including; Washington Department of Ecology, Nez Perce Tribe, Kootenai Tribe, and Coeur d'Alene Tribe. On-site visits to northern Idaho fields occurred during the week of August 29th-September 2nd with travel mainly confined to the northern Panhandle and Boundary County. Visits to northern Idaho air sheds, during the burning season are rare and difficult due to meteorologist's daily forecast duties. Regional visits are encouraged to occur annually to aid field coordinators with difficult smoke management areas and to discuss ways to identify optimum weather conditions in the field. This is an important part of the meteorological program to make sure all coordinators and operational personnel, including farmers, are on the same page meteorologically. Possibly the 2017 burning season will allow a chance to visit more of these burning areas prior to, or during, the 2017 Crop Residue Burning (CRB) season.

Burning Season Weather by Month in brief:

August:

The 2016 CRB season began with full operational forecasts on August 1st, 2016. The upper level weather pattern was one of transition as an upper level low pressure system approached off Vancouver Island and a weak ridge axis was located due west of Idaho (Figure 1). Ambient wildfire smoke was the major impact to burning across much of central Idaho at this time with further impacts driven by regional Red Flag Warnings issued by the National Weather Service.

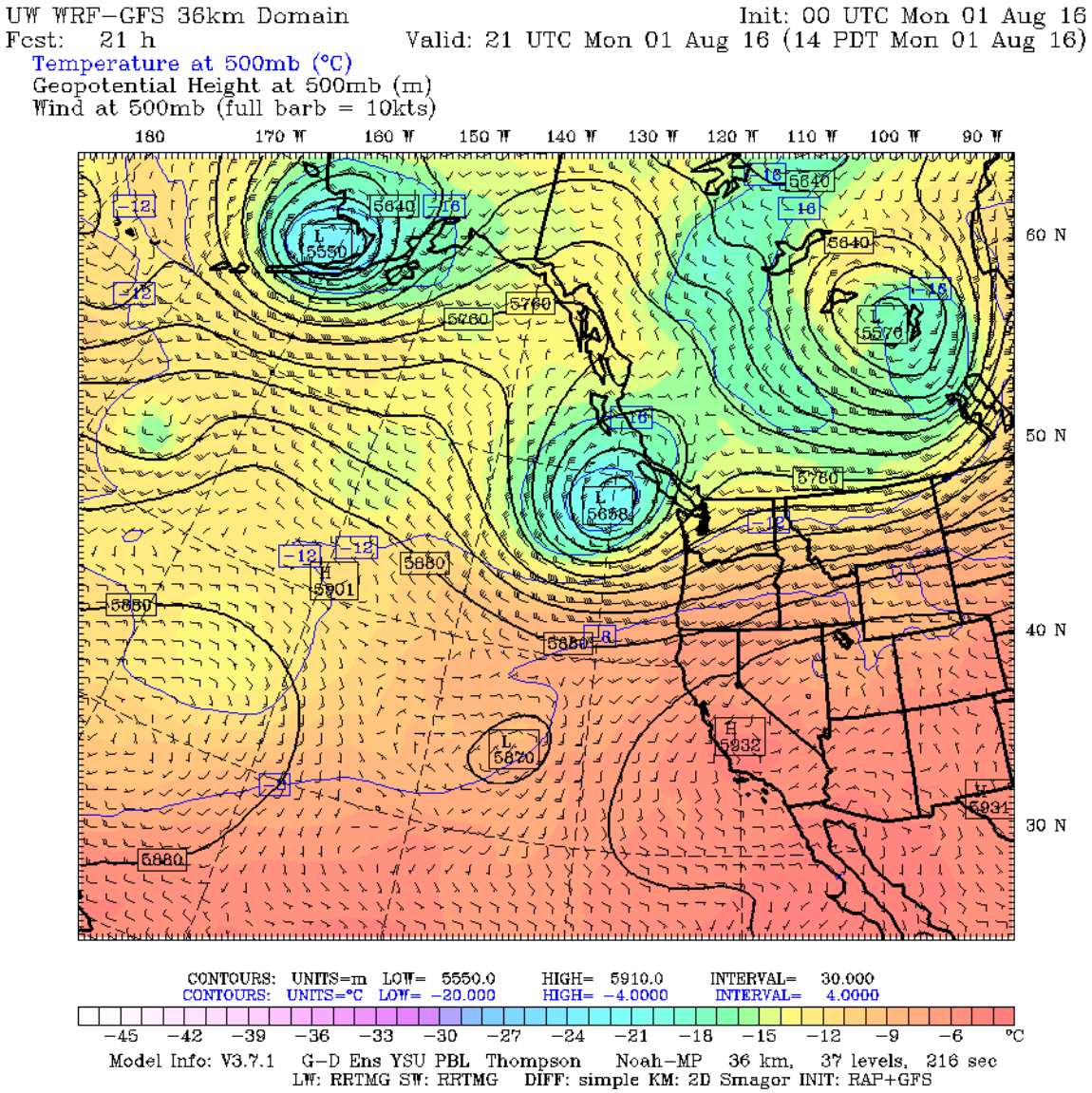

Figure 1: 500mb Temperature initialized 00Z 01 August 2016 and valid 21Z 01 August 2016.

By the second week of August, the upper level low pressure system had strengthened and settled over central Washington. This provided consistent southerly winds over northern Idaho and brought precipitation early in the week which hampered burning due to increase soil and fuel moisture (Figure 2). Lewiston received nearly a quarter of an inch (0.21") over the 8th and 9th while Spokane received 0.15" in a 24 hour period on the 9th. This system would prove to be the only precipitation received by northern Idaho over the remainder of the month, leaving most regions in a net monthly deficit of precipitation received. By the end of the week, conditions had improved to allow for burning through the region.

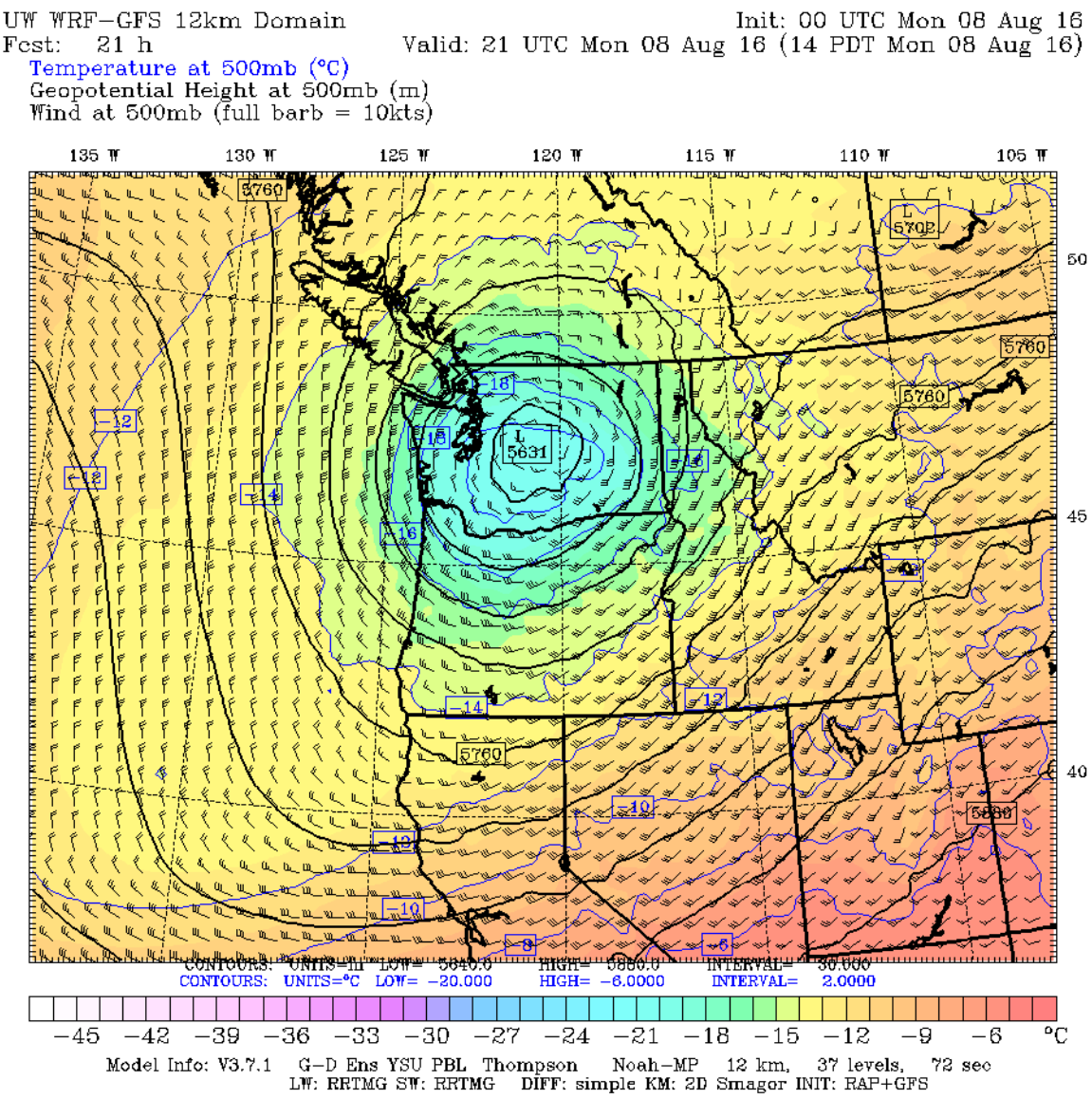

Figure 2: 500mb Temperature initialized 00Z 08 August 2016 and valid 21Z 08 August 2016.

By mid-August, a weak ridge has become established over northern Idaho/eastern Washington and a deep thermal tongue had developed over much of Washington, Oregon, and influenced parts of the northern Idaho Panhandle (Figure 3). Due to the positioning of the upper level ridge axis, winds were generally from the northwest. This resulted in marginal burning conditions across the Panhandle while Central Idaho experienced good burning conditions. A dry cold front brought strong winds across the region towards the end of the week.

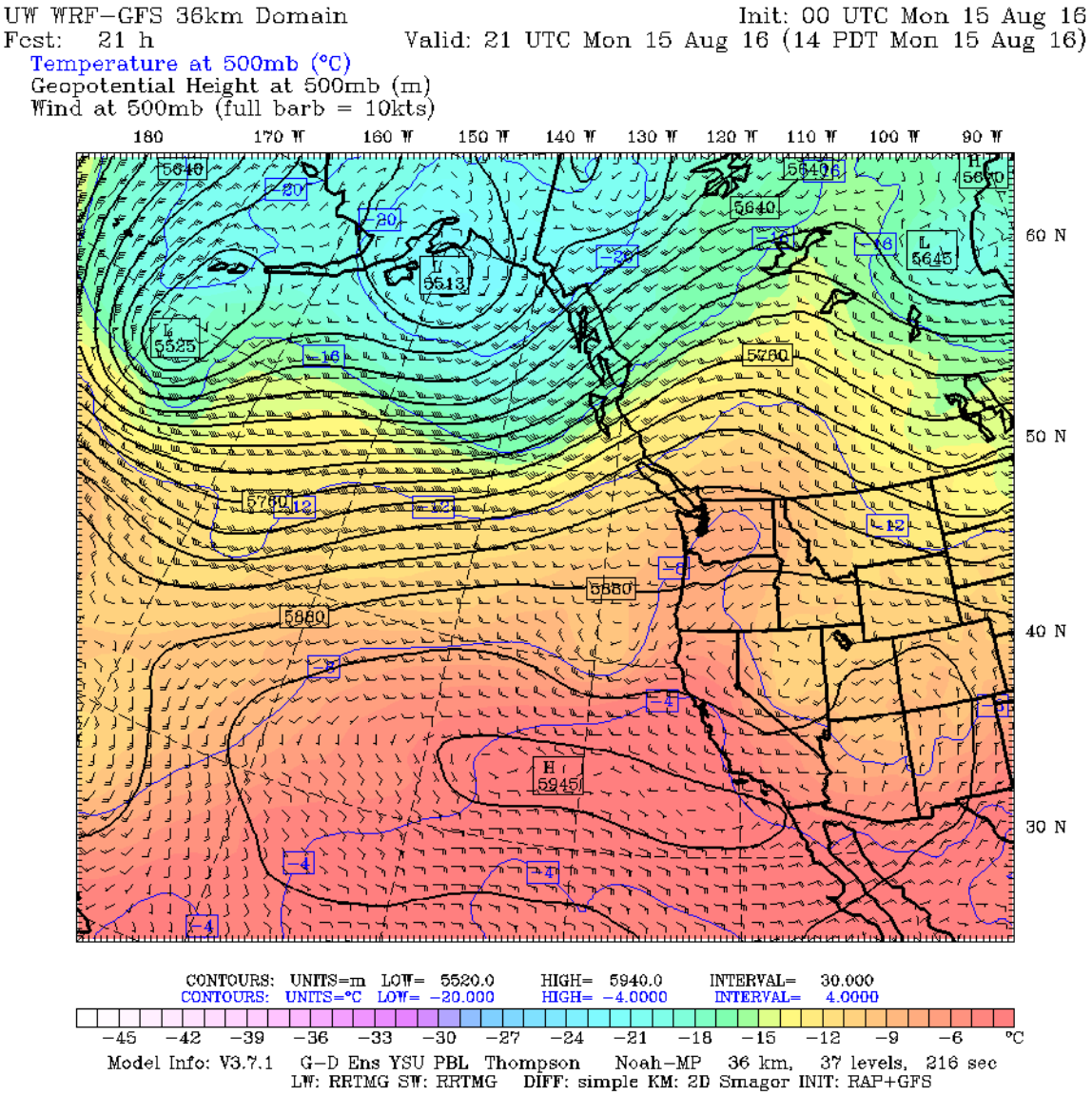

Figure 3: 500mb Temperature initialized 00Z 15 August 2016 and valid 21Z 15 August 2016.

By the 22nd, a vigorous upper level low pressure system moved across the extreme northern Panhandle bringing a dry cold front (Figure 4). This prompted Red Flag Warnings from the NWS and AQA burn bans from DEQ across the northern Panhandle early in the week due to strong winds and ambient wildfire smoke. Central Idaho did not experience impacts from the system to the same degree and was generally unaffected. By late week, conditions had improved to promote burning across all north Idaho airsheds.

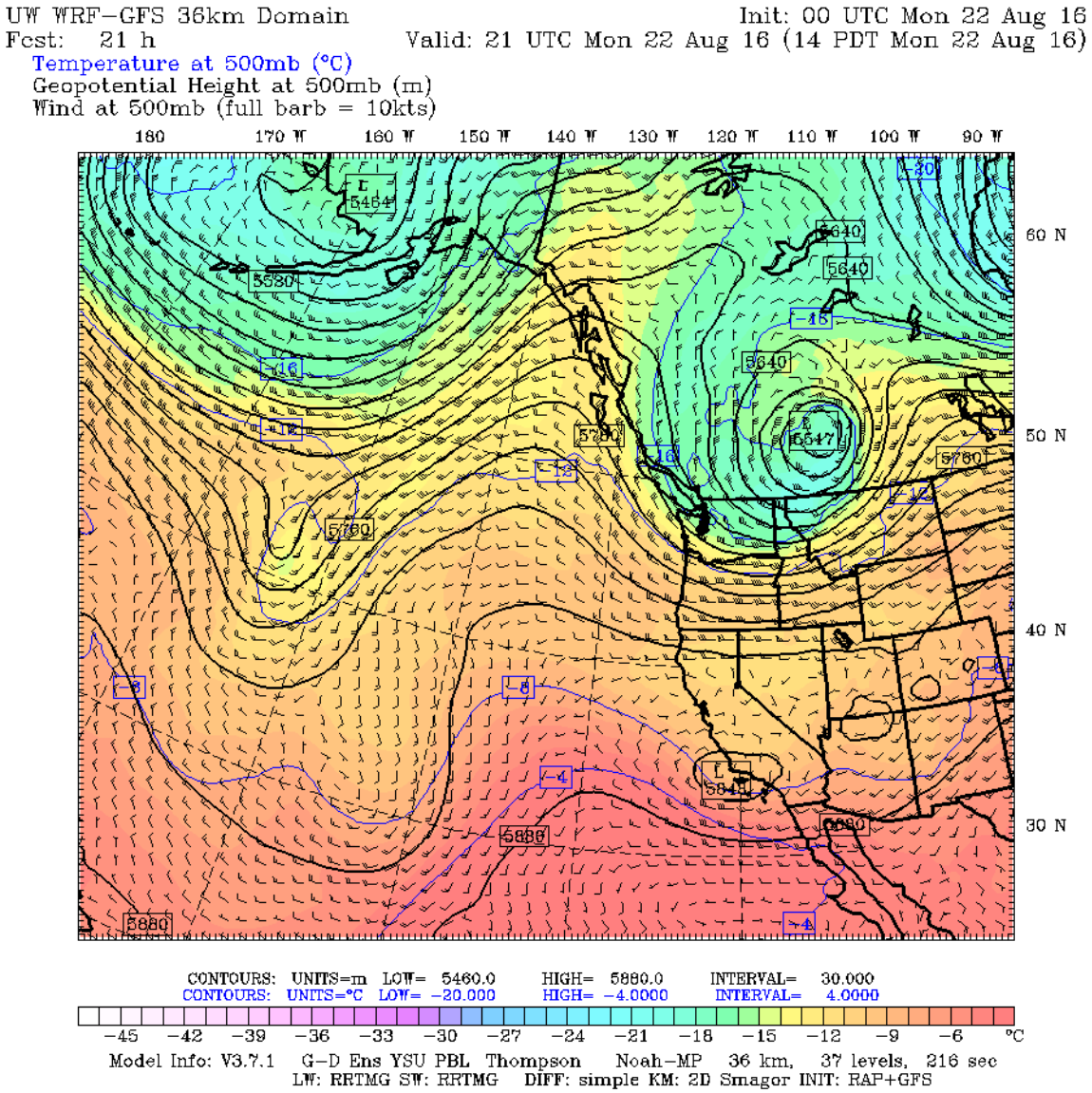

Figure 4: 500mb Temperature initialized 00Z 22 August 2016 and valid 21Z 22 August 2016.

The last week of August saw an upper level low pressure system west of Haida Gwaii which then amplified a ridge of high pressure over north Idaho. This system was incredibly slow-moving and was quasi-stationary throughout the week, sending lobes of energy over the region (Figure 5). This generated a very difficult and complex pattern to identify as mixing was sporadically inhibited at the lower levels and skies were clear (Figure 6). The end of the week brought a threat of showers that never materialized over the extreme Panhandle as well as the end of August.

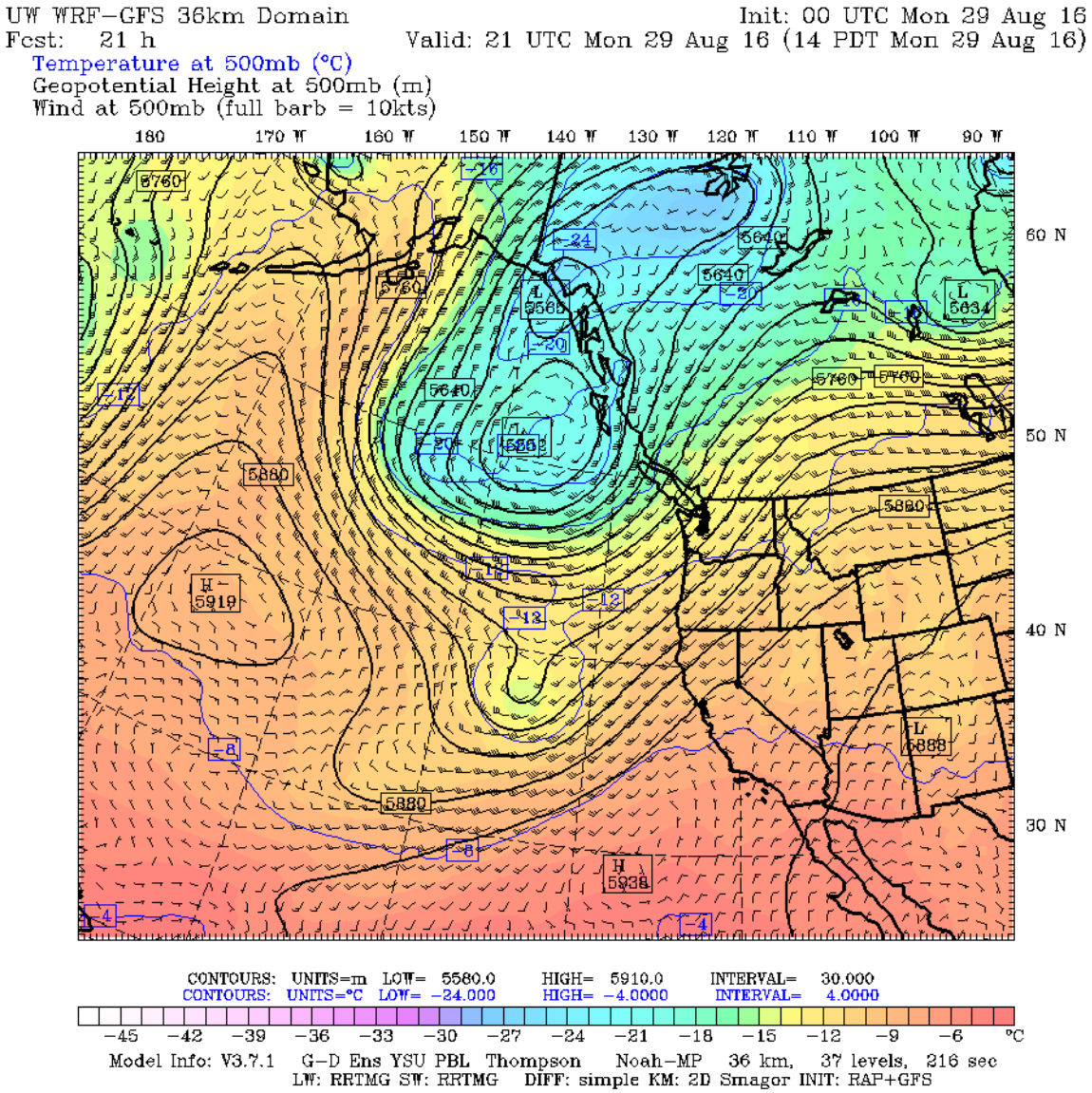

Figure 5: 500mb Temperature initialized 00Z 29 August 2016 and valid 21Z 29 August 2016.

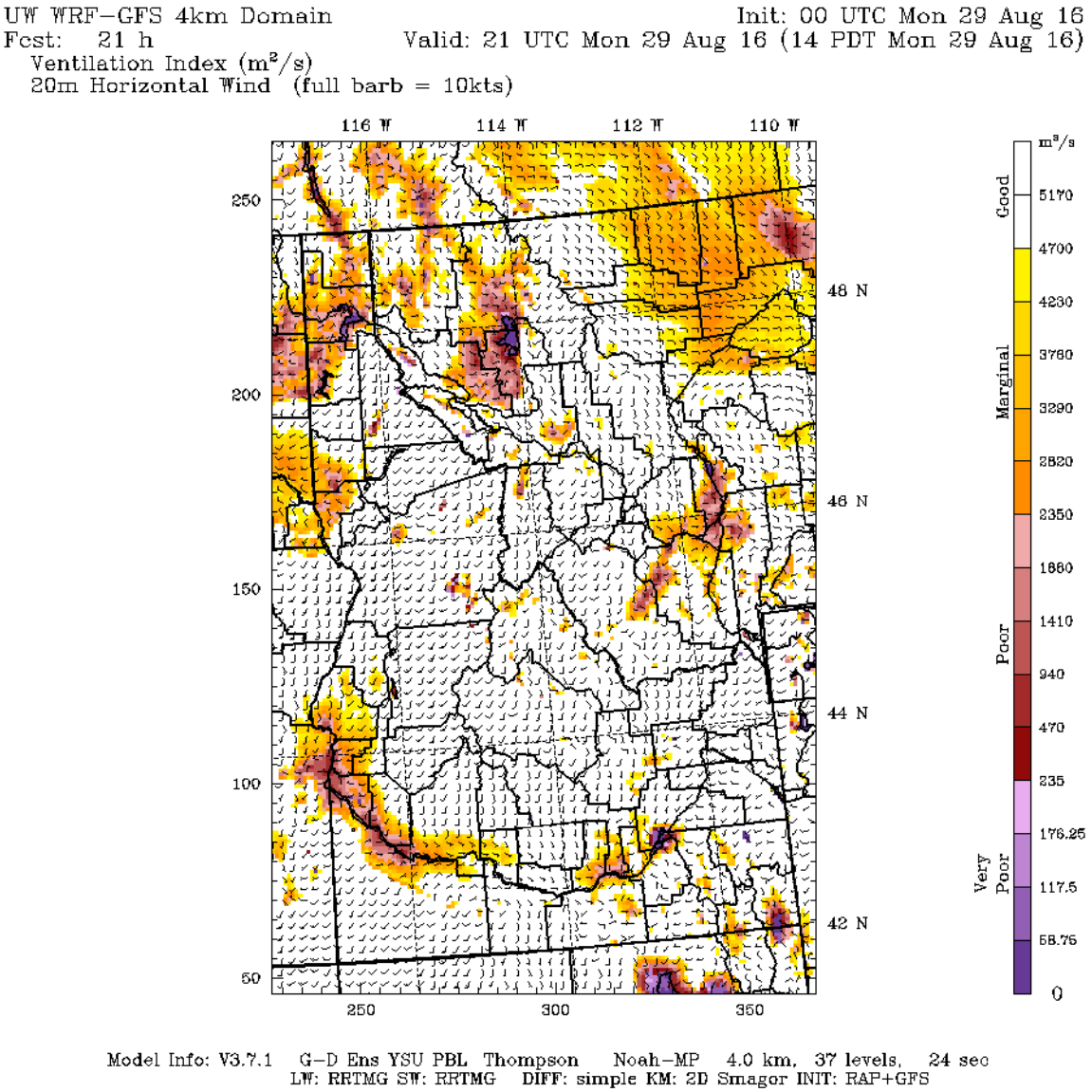

Figure 6: 4km Ventilation Index initialized 00Z 29 August 2016 and valid 21Z 29 August 2016.

September:

By the end of the week the stubborn upper level low pressure system had weakened, filled, and tracked east of Idaho into the Dakotas; however, prior to its vacating the unstable air mass had generated showers across the north Idaho landscape from Lewiston to Spokane. Lewiston received 0.37" on the 6th, which represented two-thirds of the monthly observed precipitation for the area. This moisture hampered the agricultural burning for the week across much of central Idaho as fuels and soils needed time to dry. The northern Panhandle received only traces of precipitation over this time and rebounded to promote desired burning conditions much more quickly. As the upper level low pressure meandered east, a shallow ridge developed over the Pacific Northwest and much of British Columbia and Alberta, Canada (Figure 7).

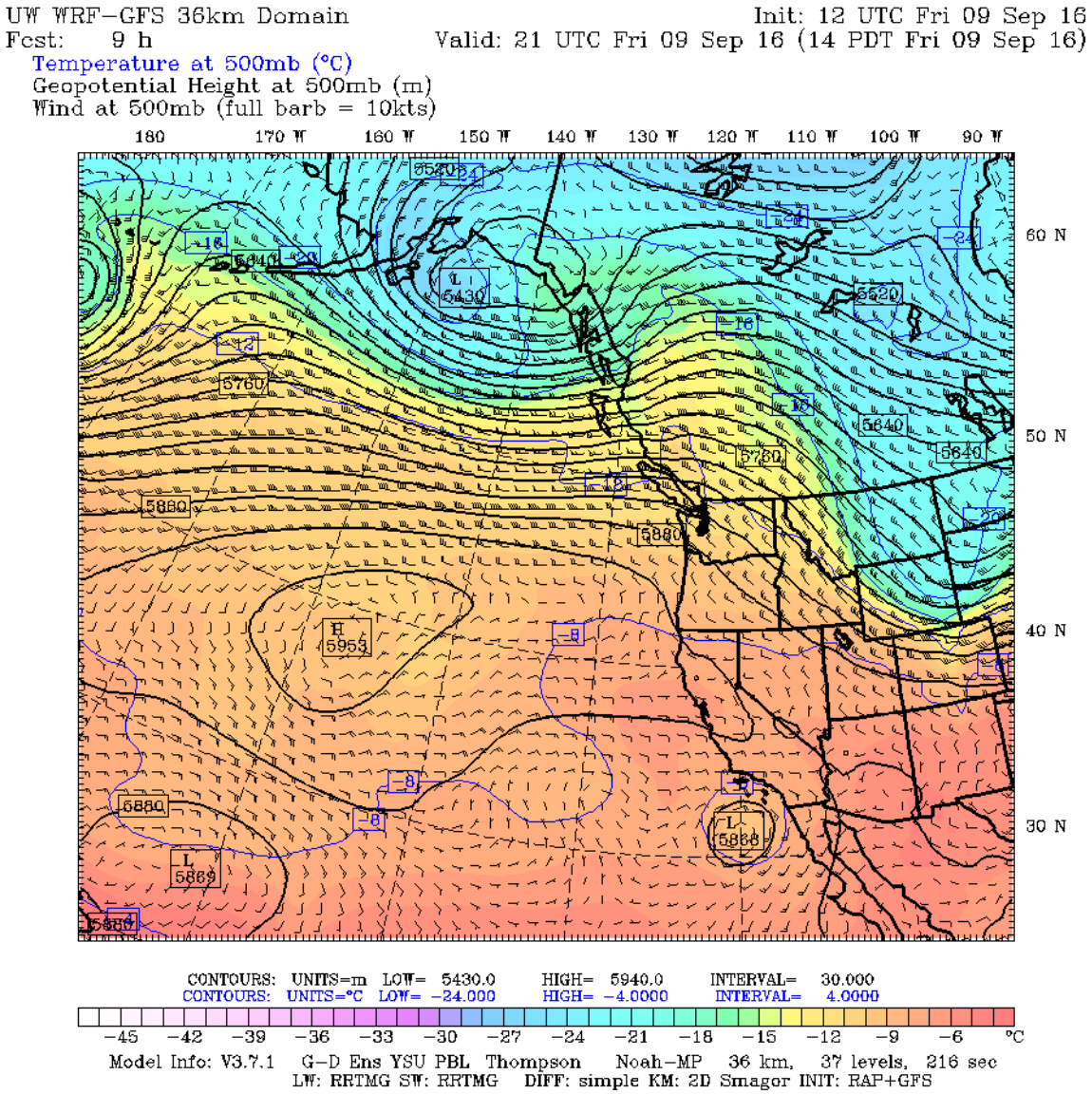

Figure 7: 500mb Temperature initialized 12Z 09 September 2016 and valid 21Z 09 September 2016.

By the beginning of the week of the 12th, an upper level low pressure system had begun to retrograde and was in the process of becoming cut off. This action, with influences from the semi-permanent Pacific high pressure, resulted in a highly-amplified upper level ridge with the lee side located over northern Idaho (Figure 8).

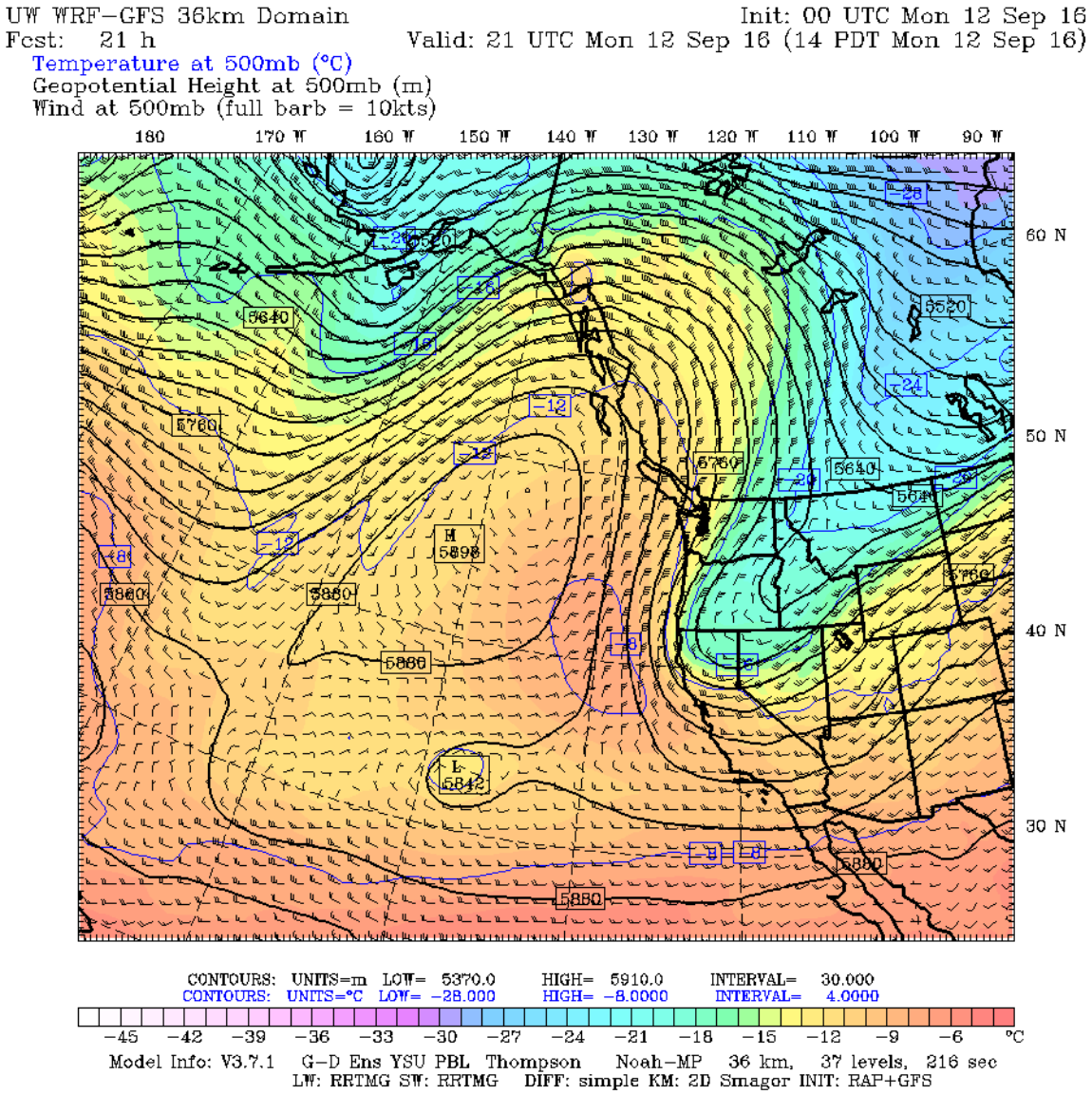

Figure 8: 500mb Temperature initialized 12Z 12 September 2016 and valid 21Z 12 September 2016.

By the end of the week of the 12th, a secondary low pressure system rotating around its parent in the Gulf of Alaska suppressed the ridge over the eastern Pacific and Pacific Northwest. This promoted a zonal (westerly) flow pattern to establish before diving south due to the elongated upper level trough that was still in the process of becoming cut-off (Figure 9).

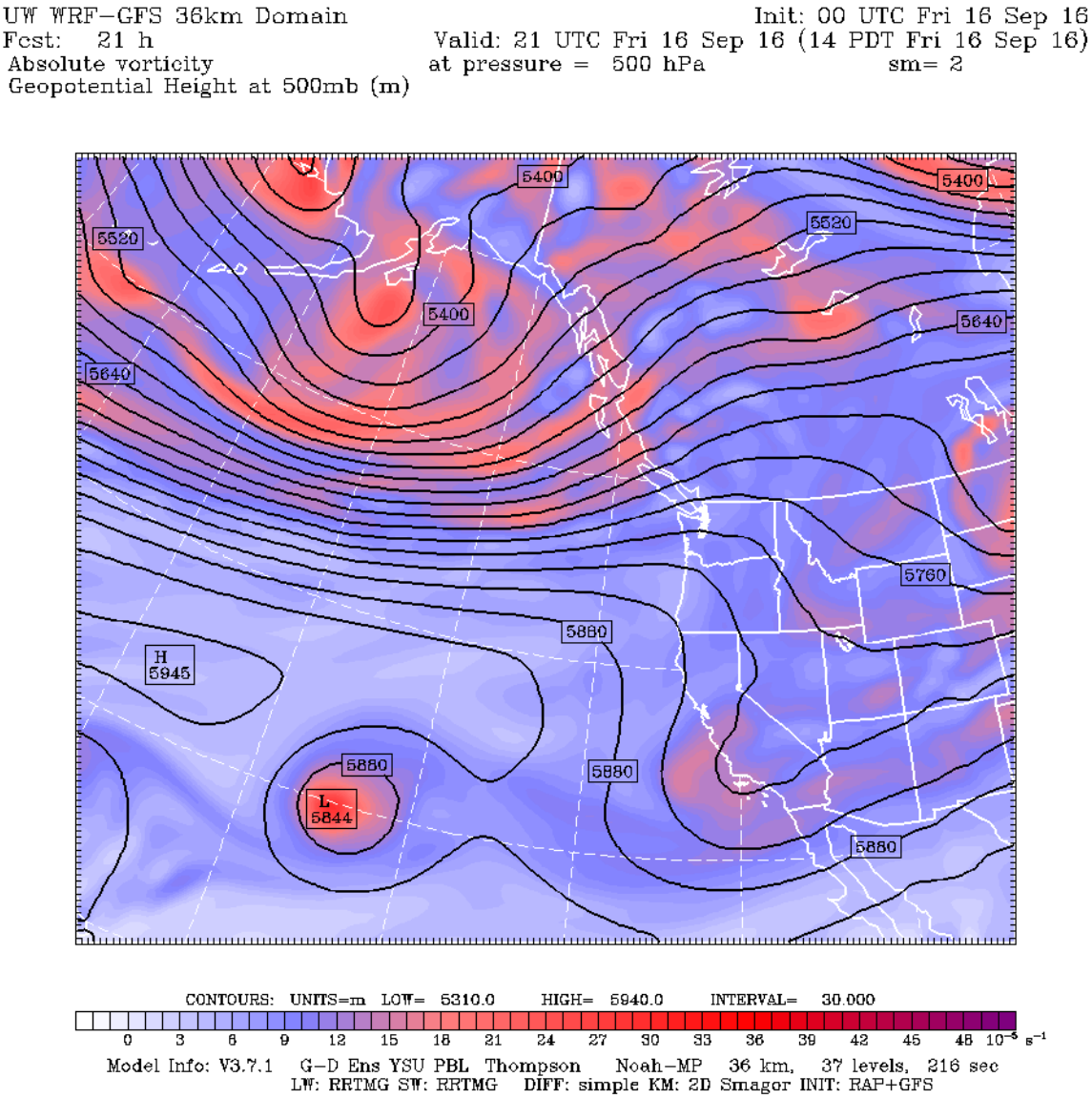

Figure 9: 500mb Vorticity initialized 00Z 16 September 2016 and valid 21Z 16 September 2016.

While the ridge was no longer the dominating weather feature over the area, it remained influential such that the regions near the remnants of the ridge axis experienced widespread sinking air and poor dispersion characteristics through the week of the 12th (Figure 10).

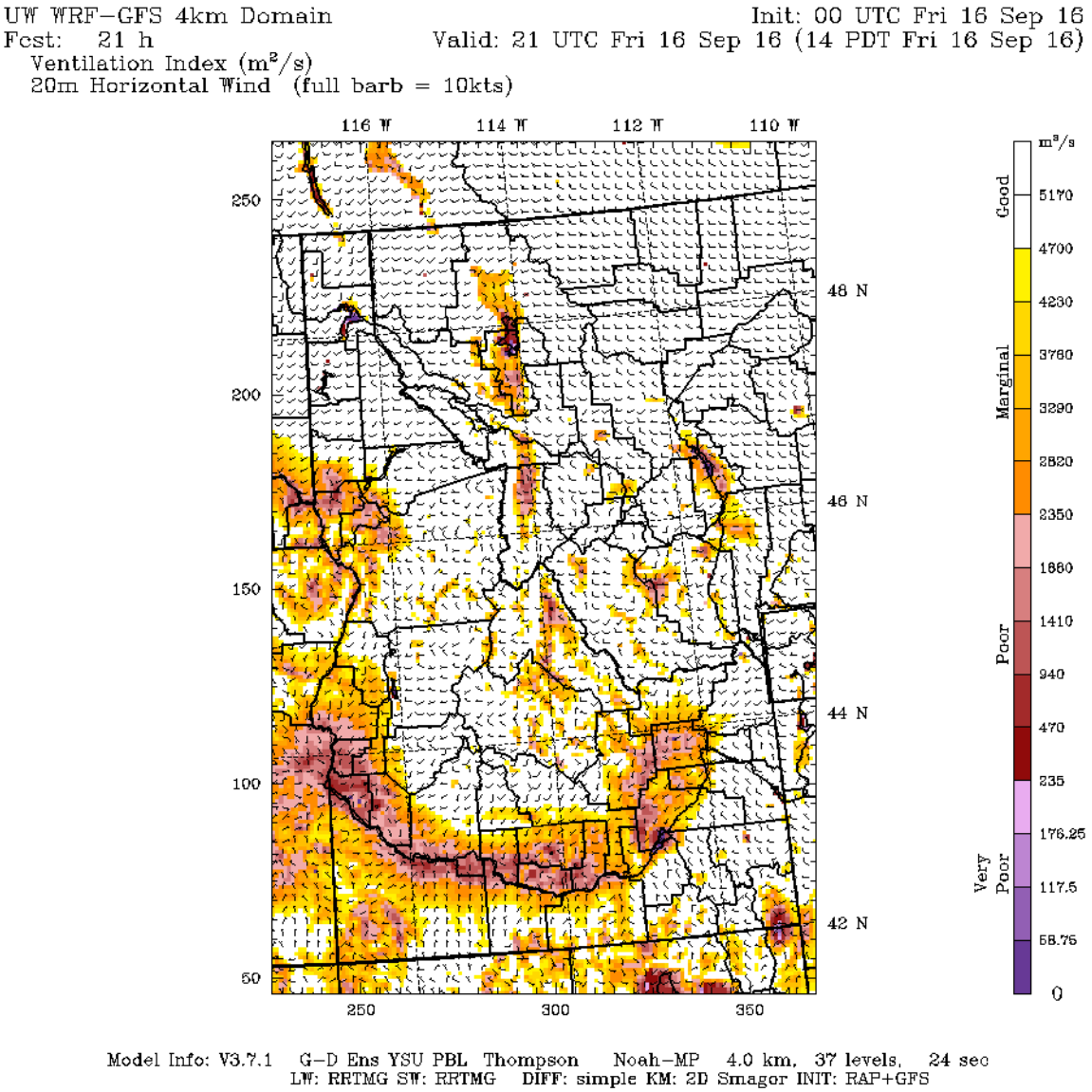

Figure 10: 4km Ventilation Index initialized 00Z 16 September 2016 and valid 21Z 16 September 2016.

Weekend precipitation on the 19th and 20th across northern Idaho limited early week burning opportunities as a zonal flow pattern established (Figure 11). Characteristics of a zonal pattern are quite weak, thereby allowing the most minor of disturbances to drastically influence the region.

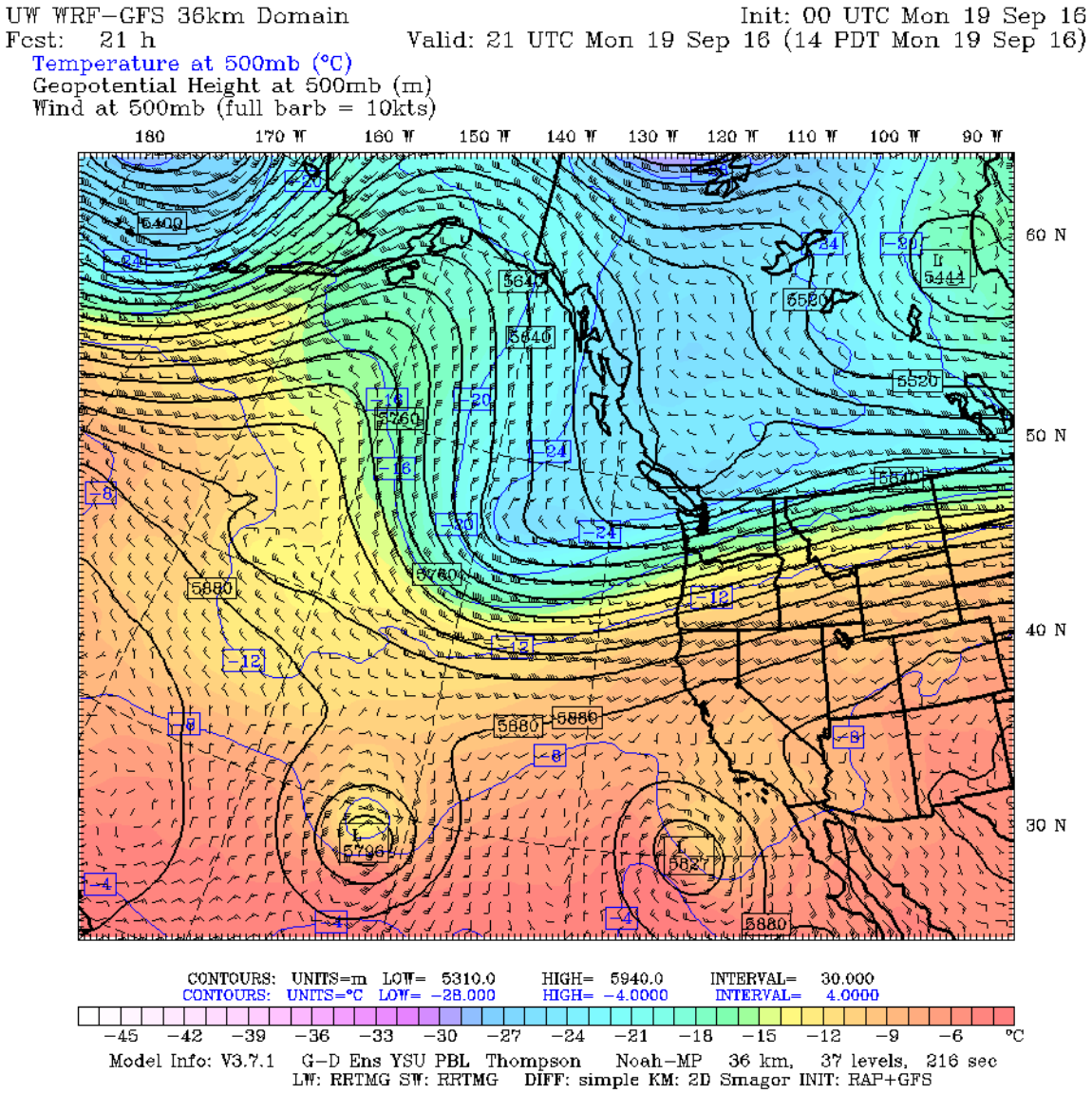

Figure 11: 500mb Temperature initialized 00Z 19 September 2016 and valid 21Z 19 September 2016.

By Friday September 23, the upper level low pressure system off the southern California coast had become entrained within the mean flow and traveled to the northeast into southeast Idaho while a trough axis extended from northern British Columbia southeast into northern Idaho (Figure 12). This allowed for a smattering of precipitation over both northern and central Idaho.

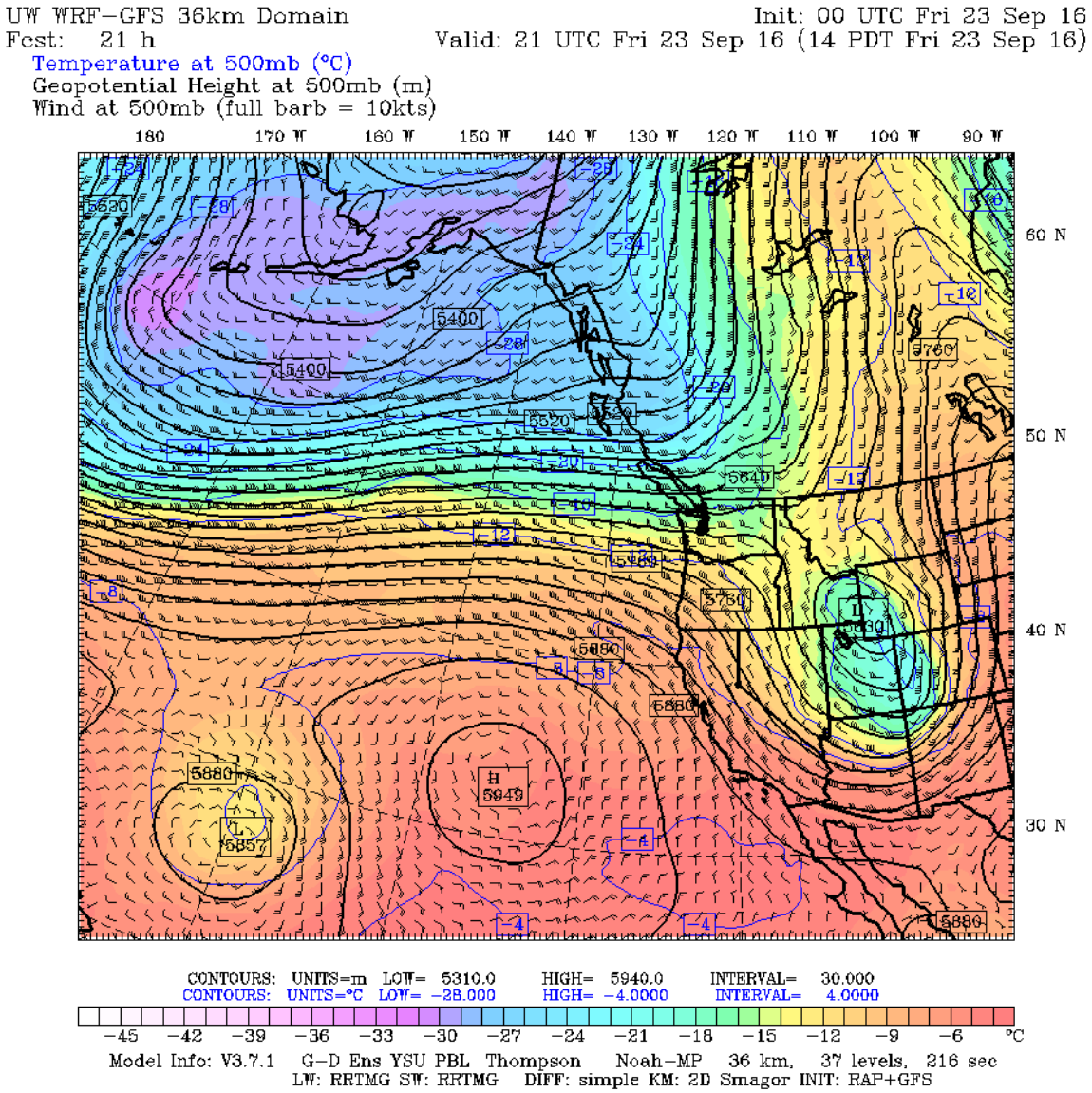

Figure 12: 500mb Temperature initialized 00Z 23 September 2016 and valid 21Z 23 September 2016.

As the upper level low pressure system tracked to the northeast, the last week of September saw a strong mid-level high pressure system with a center directly over south-central Idaho (Figure 13) develop. This limited ventilation and dispersion throughout much of southern Idaho and portions of north Idaho (Figure 14).

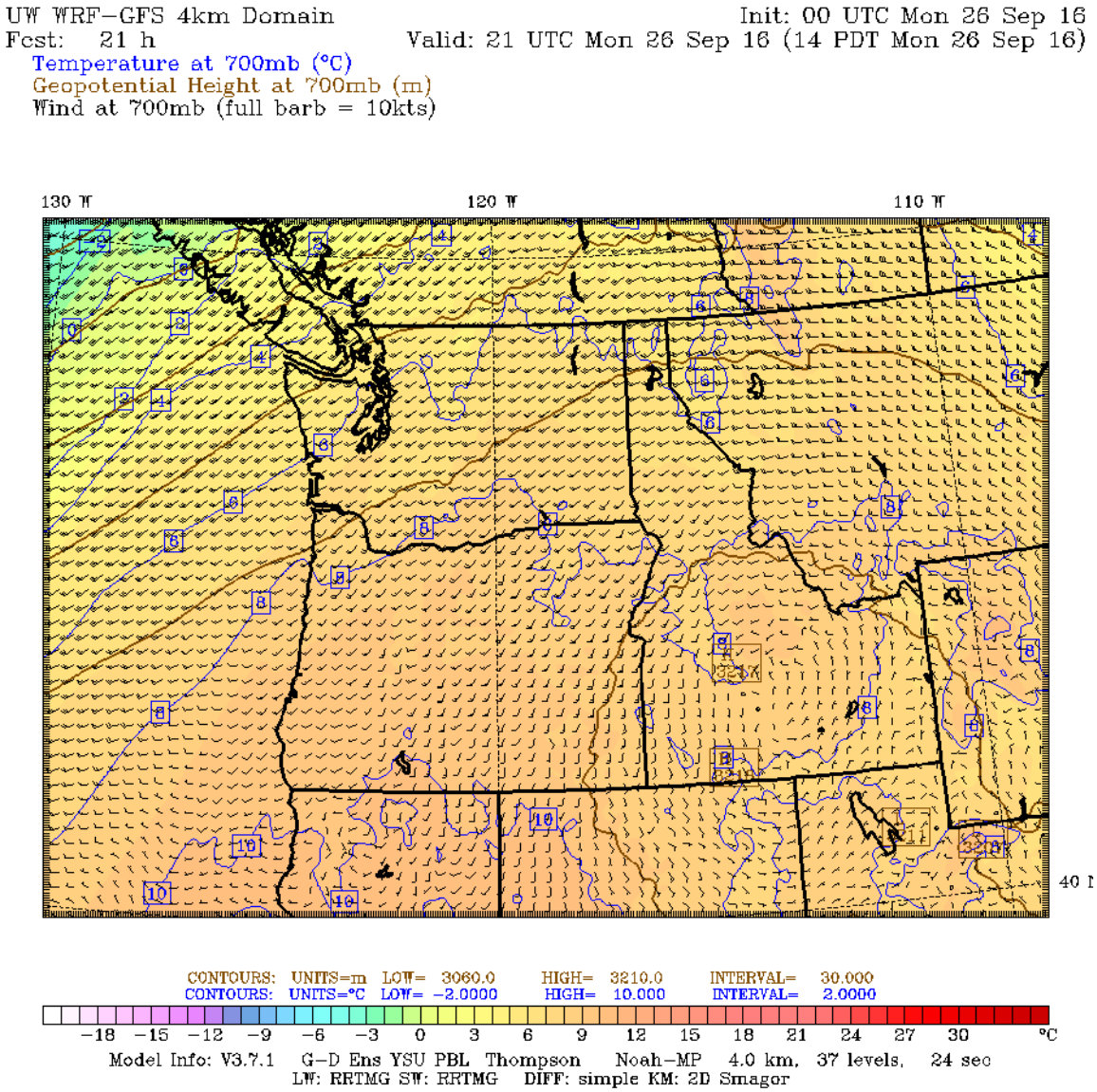

Figure 13: 700mb Temperature initialized 00Z 26 September 2016 and valid 21Z 26 September 2016.

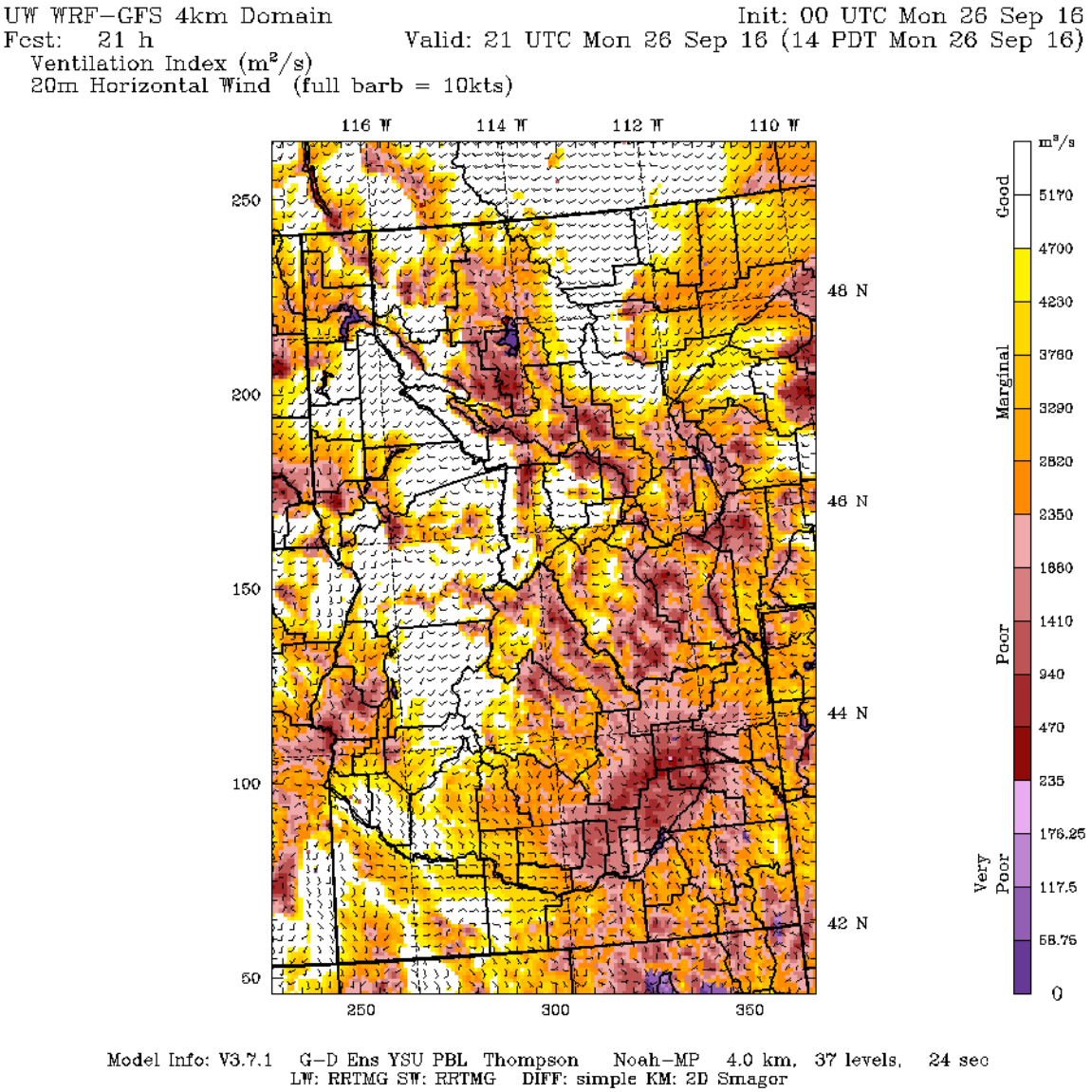

Figure 14: 4km Ventilation Index initialized 00Z 26 September 2016 and valid 21Z 26 September 2016.

By the end of the final week in September, the ridge of high pressure had moved away from Idaho due to the approach of a secondary upper level low pressure system (off the coast of Washington) and its parent (directly over and north of Haida Gwaii) as indicated in Figure 15.

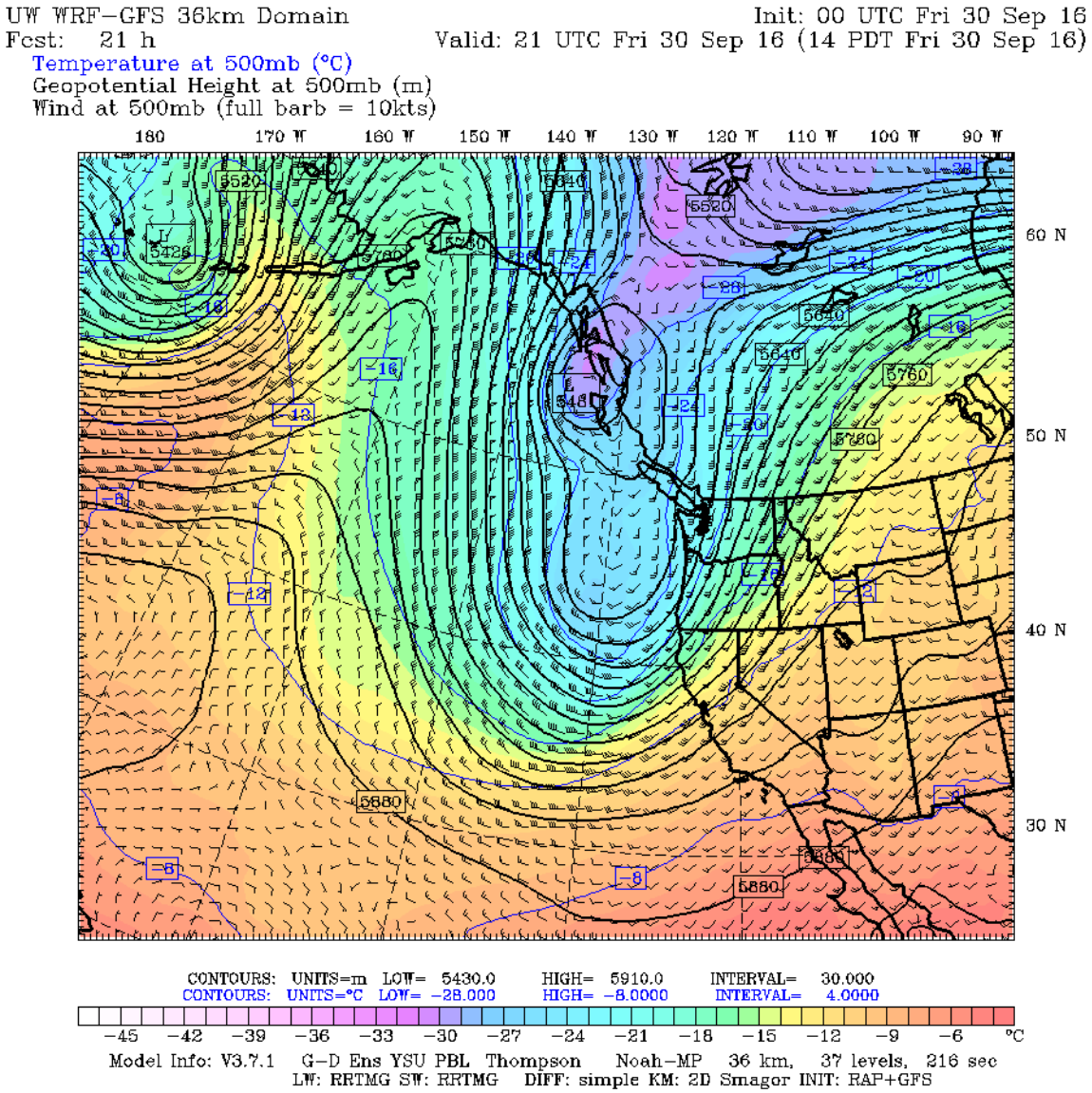

Figure 15: 500mb Temperature initialized 00Z 30 September 2016 and valid 21Z 30 September 2016.

This brought a threat of precipitation to the northern Panhandle and drove strong surface winds through central Idaho. Both events materialized as precipitation was recorded from Lewiston north to Spokane with winds from 17-28 mph over the various northern Idaho airsheds.

October:

The first week of October brought a continued active weather pattern to the northern Idaho airsheds. An upper level low pressure system was located over southeast Idaho while an associated trough axis ran directly through central Idaho from Haida Gwaii. This led to the establishment of a complicated flow pattern with winds west of the axis flowing northwest, winds directly east of the axis flowing south, whereas the winds around the closed low circulated

counter clockwise around its center (Figure 16) and were from the northeast-east over northern Idaho.

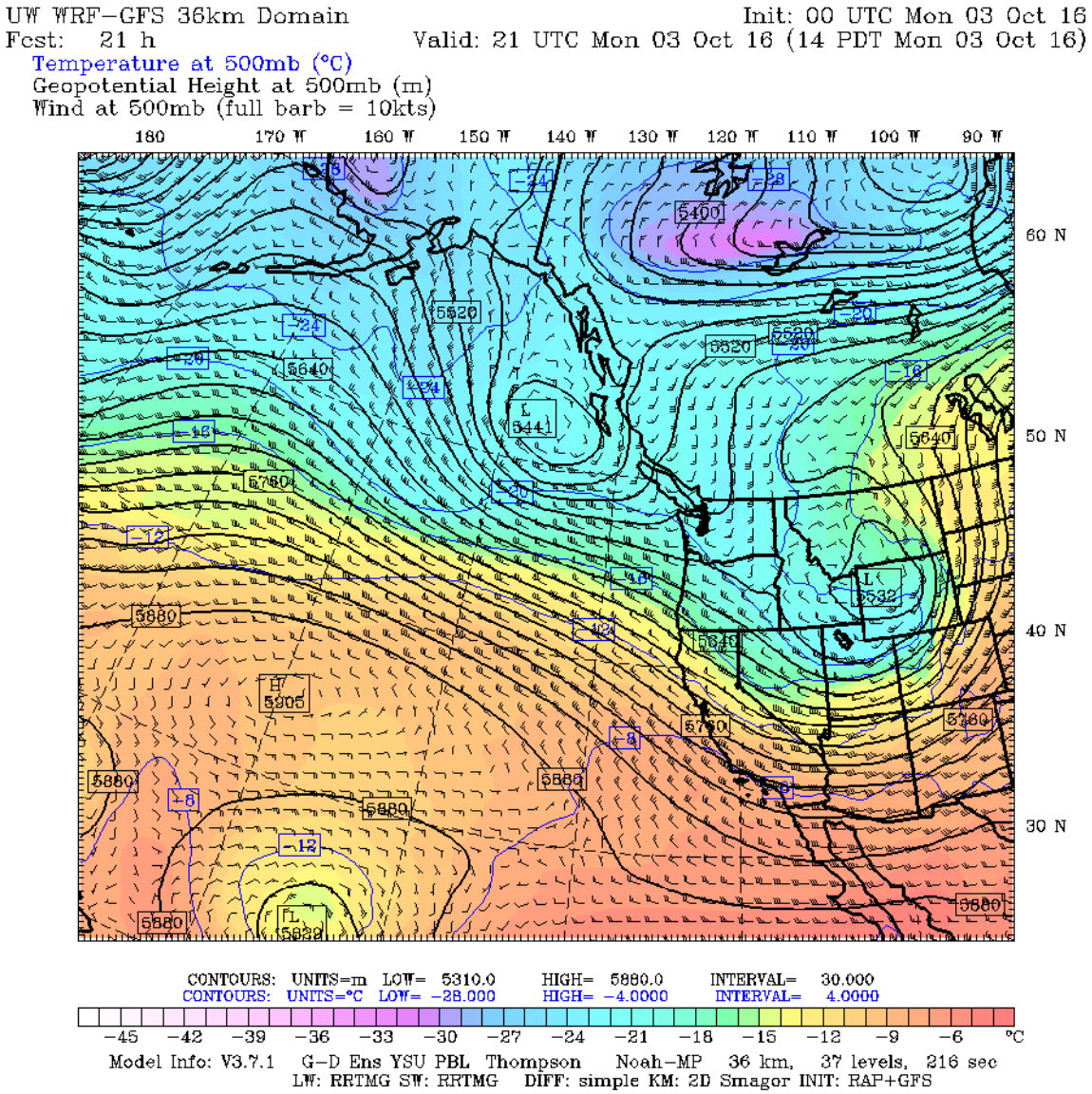

Figure 16: 500mb Temperature initialized 00Z 03 October 2016 and valid 21Z 03 October 2016.

By the end of the first week, a zonal flow pattern had established (Figure 17) and ample precipitation (around one-third of an inch) fell on Friday across central and northern Idaho. Surface winds reached 33-34 mph sustained.

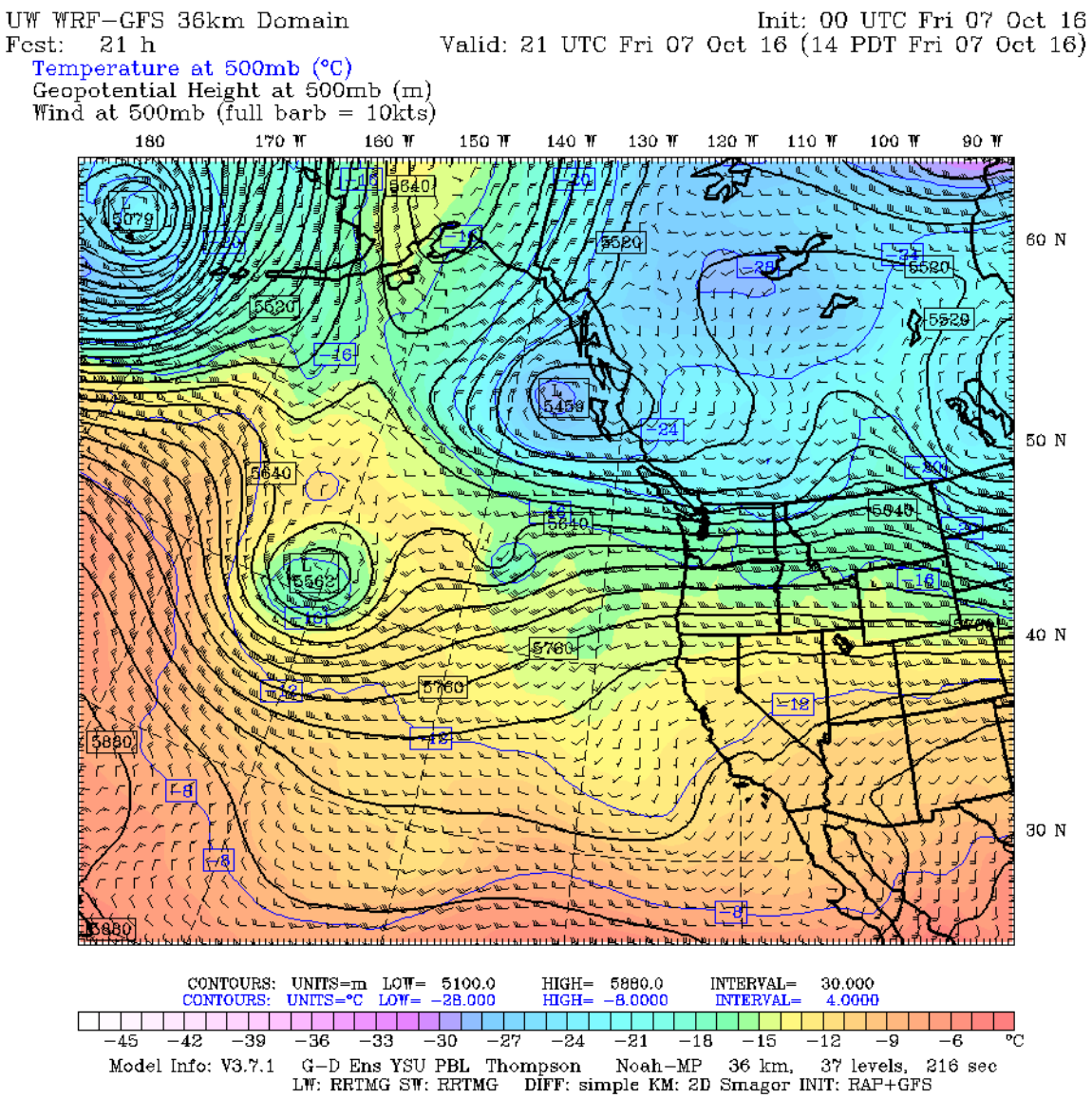

Figure 17: 500mb Temperature initialized 00Z 07 October 2016 and valid 21Z 09 October 2016.

An elongated upper level low pressure system extending from the Bering Sea to the eastern Pacific off the coast of Oregon forced a shortwave ridge along the immediate Pacific Coast which then promoted cold, continental polar air into northern Idaho early in the week (Figure 18).

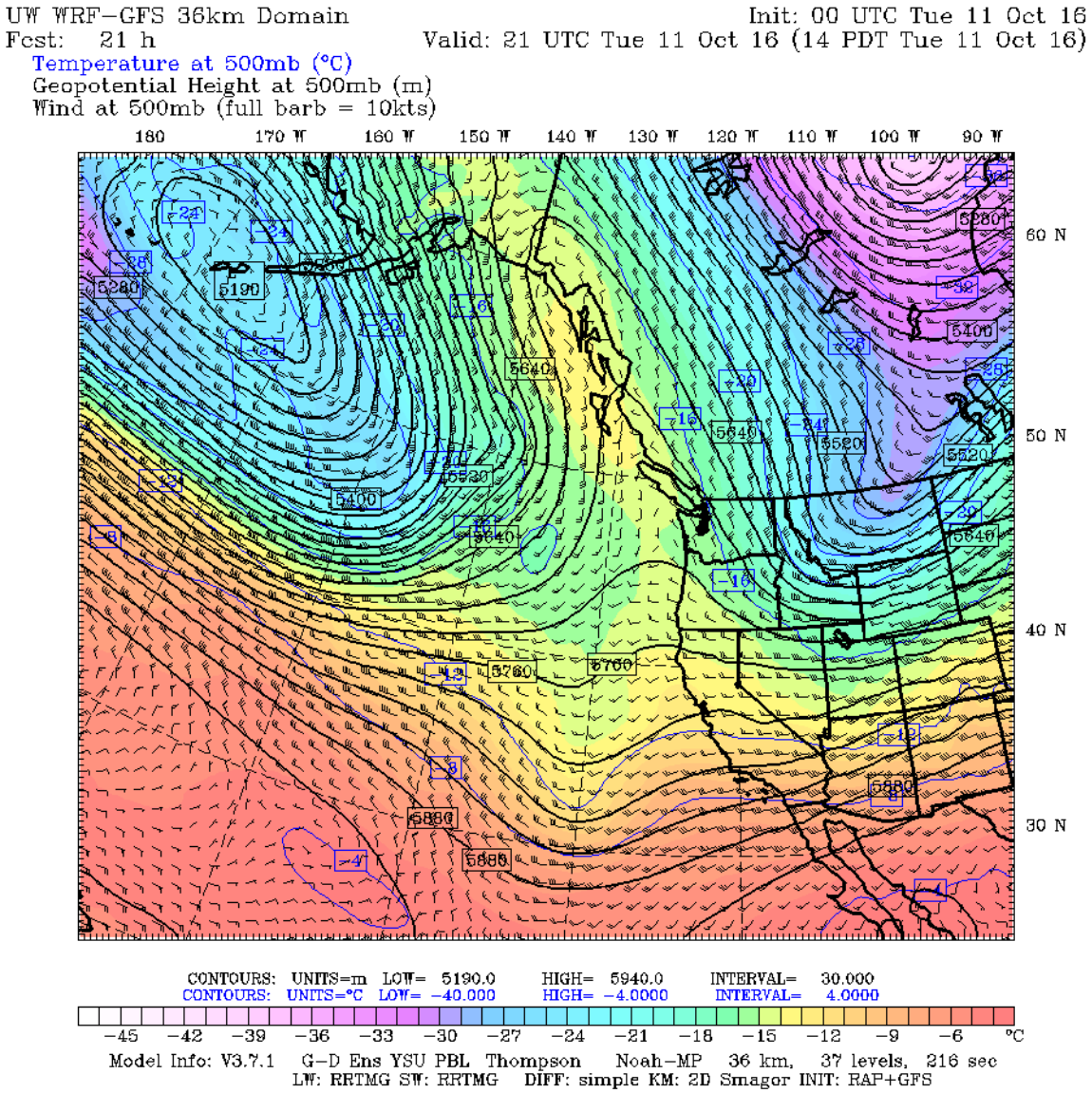

Figure 18: 500mb Temperature initialized 00Z 11 October 2016 and valid 21Z 11 October 2016.

October 17th would be one of the few remaining dry days across northern Idaho as beginning on October 13th, rain was observed every day until the 23rd across the panhandle and the 22nd across central Idaho (as well as the day of the 19th). This precipitation inhibited most burning opportunities across all airsheds. Figure 19 indicates that a typical winter weather pattern has become established, noted by the marked temperature gradient south of Idaho, the semi-permanent Pacific High moving to the south and west, and minor, continuous embedded shortwave disturbances approaching the Pacific Northwest from a strong, deep, quasi-stationary upper level low pressure system sitting in the Gulf of Alaska.

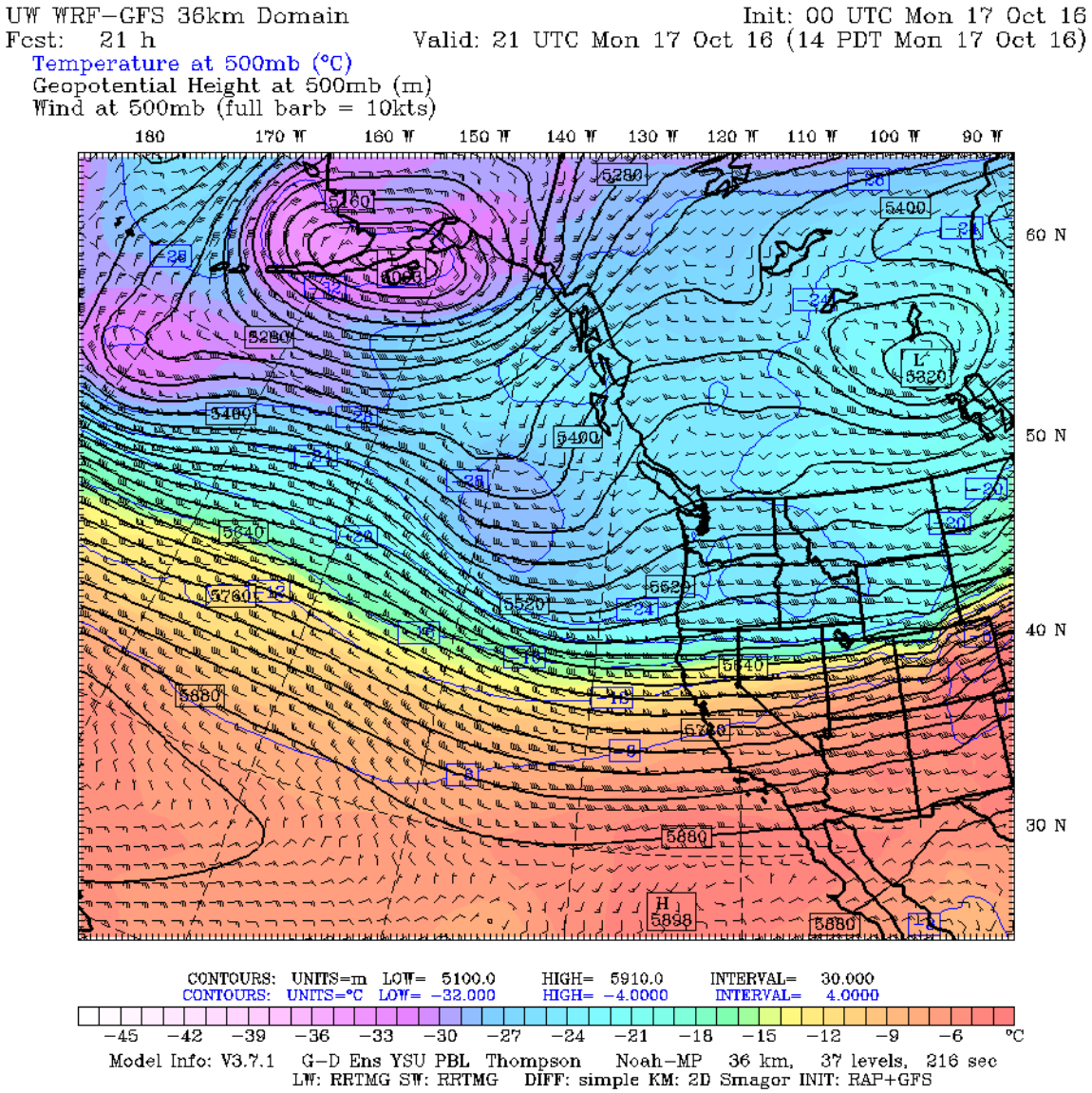

Figure 19: 500mb Temperatures initialized 00Z 17 October 2016 and valid 21Z 17 October 2016.

Ventilation concerns persisted during this time as cold, moist air would inhibit any vertical lift on smoke through the lower valleys and basins (Figure 20).

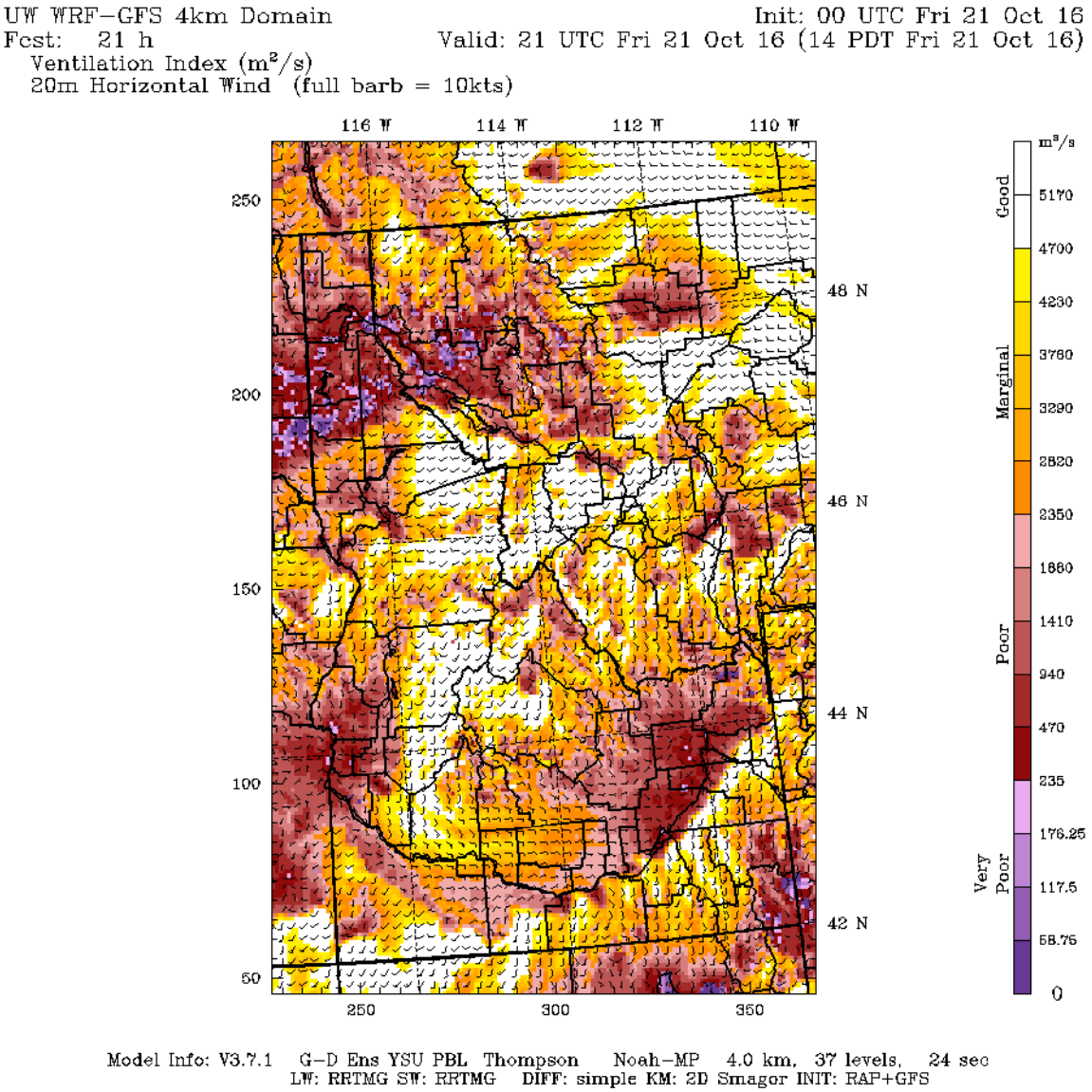

Figure 20: 4km Ventilation Index initialized 00Z 21 October 2016 and valid 21Z 21 October 2016.

One final opportunity to burn came in the penultimate week of the month when northern Idaho came under a transition from a weekend ridge system and an incoming upper level low pressure system (Figure 21). While a threat of showers remained over all airsheds, the remaining regions still able to burn were confined to central Idaho which received no rain during the early part of the week. Ventilation and dispersion were of no concern and the only limiting factors were due to potentially strong pre-frontal winds as the system approached (Figure 22).

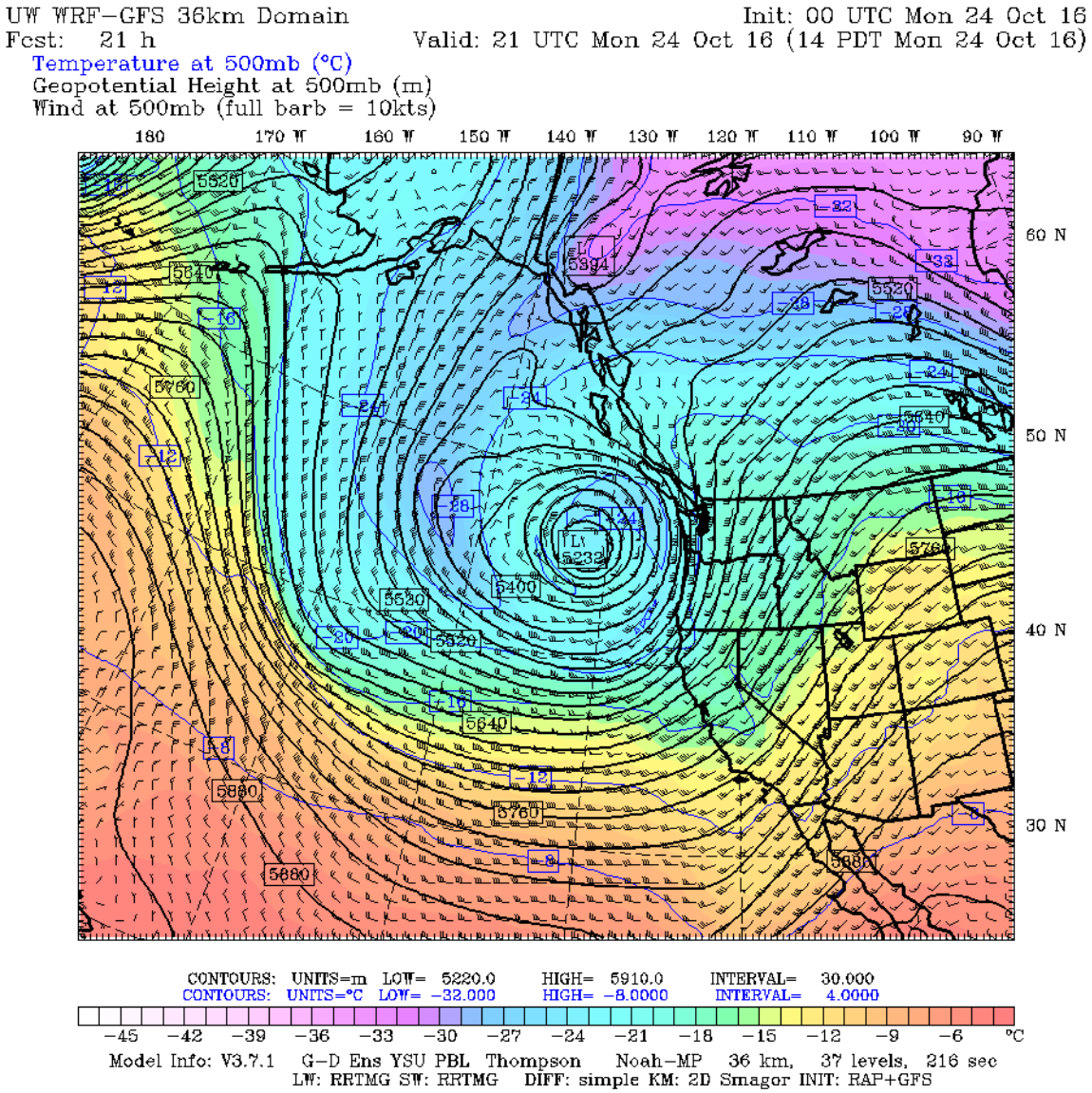

Figure 21: 500mb Temperature initialized 00Z 24 October 2016 and valid 21Z 24 October 2016.

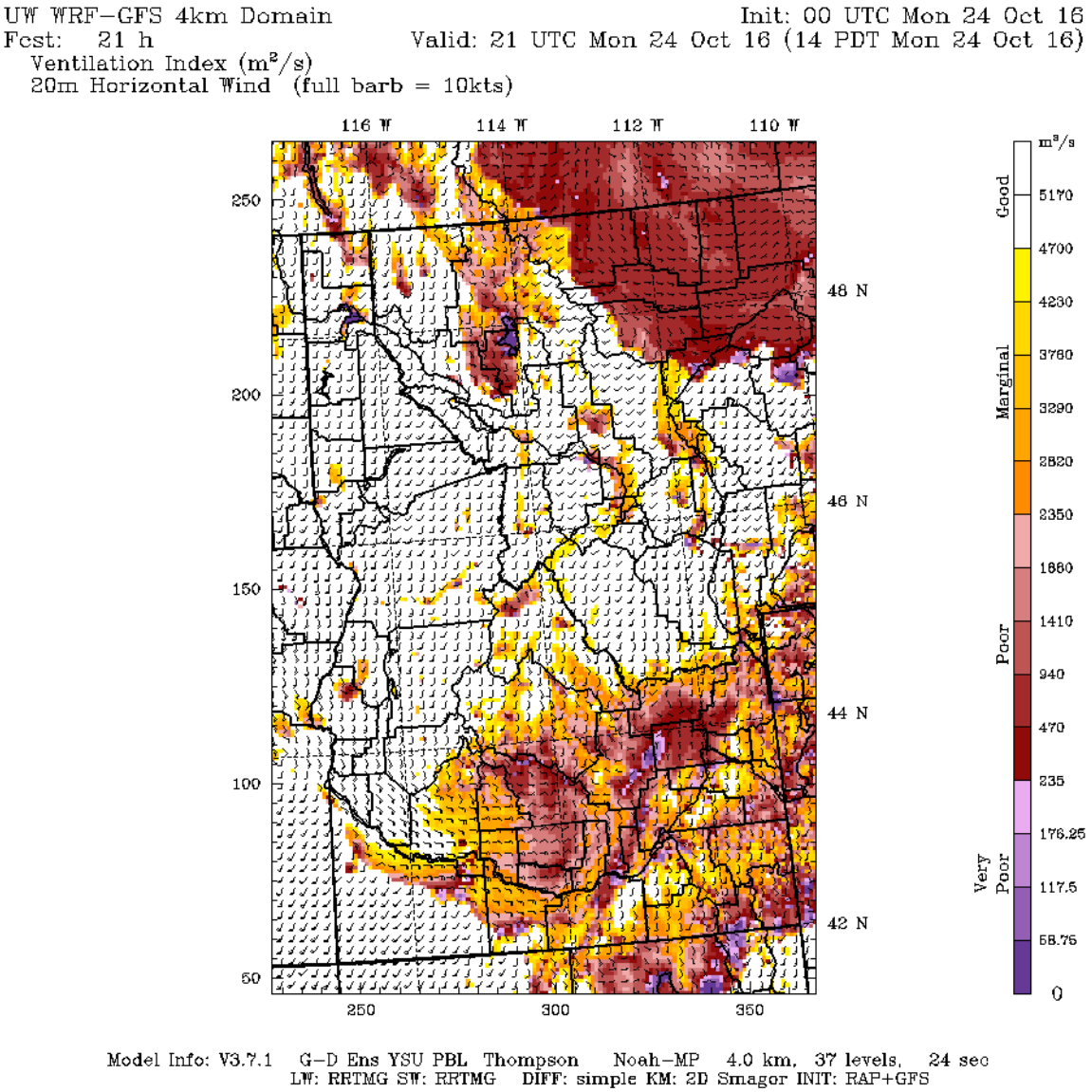

Figure 22: 4km Ventilation Index initialized 00Z 24 October 2016 and valid 21Z 24 October 2016.

By the 25th, the rain had arrived and provided the season-ending event across northern Idaho. Daily forecasts were continued through the week and the last week of October saw an extended forecast that covered through in detail the first week of November with a broad overview of the rest of November included.

Conclusion:

The 2016 agriculture field burning season was hampered early on by wildfire smoke, but once into mid-august, several cool fall-like showers limited fire activity and the associated smoke production. Wildfire issues did not re-emerge after that point this season. While precipitation totals were generally less than average across most of the region, the timing in which that precipitation was received inhibited burning. The amounts were quite high for daily

totals, which meant several days of drying were needed. This was atypical than the light, consistent afternoon thundershowers which would dry out the next day and allow for burning.

Model Performance

Forecast weather models especially from the ARW-WRF and NAM-4km performed generally well during the 2016 CRB season but did struggle in the complex terrain regions of the Camas Prairie and Purcell Trench within Boundary County. There exists a need to continue to improve the wind direction and speed forecasts in those trouble areas. Due to the resolution of current weather models in the area, this indicates an increased reliance on in-situ observations. There were no requests for a Burn Day Analysis in northern Idaho this season. This season included a preseason burn meeting in Moscow in early June as well as a weeklong field campaign to Coeur d'Alene with an emphasis on field observations in Boundary County. The complexity of this particular valley was noted when field readings of wind direction within 1 mile of each other read 4 different directions and speeds.

I will continue to train myself and field coordinators on northern Idaho weather patterns, especially localized wind patterns driven by terrain as well as any requests the regional office staff may have. The end of season meeting this past November contained 4 different weather trainings, including a cloud identification training and their associated impacts on field burning.

ANNUAL WEATHER SUMMARY FOR THE SMOKE DISPERSION FORECAST FALL SEASON FOR SOUTHERN IDAHO, 2016

Operations:

The 2016 Agricultural Field Burning Smoke Management program for Southern Idaho began on August 1st with full operational forecasts. Idaho Department of Environmental Quality (IDEQ) manages the Crop Residue Burning (CRB) program for portions of southern Idaho and portions of northern Idaho. Smoke dispersion forecasts were e-mailed to IDEQ recipients by 8:00 AM MDT each day of the forecast season. The delivery of forecasts via e-mail was followed by conference calls at 8:30 am MDT each day. The morning conference calls were used to discuss the weather forecast for the "burn day" (i.e. today). A brief review of the previous day's activity and results was completed prior to the weather forecast discussion on the morning call.

A pre-season meeting occurred this season on August 3rd. On-site visits to southern Idaho fields were again curtailed in 2016 due to the timing of the pre-burn meeting (occurring once full operational daily forecasts had begun). Visits to southern Idaho air sheds during the burning season are rare and difficult due to meteorologist's daily forecast duties. Regional visits are to occur annually to aid field coordinators with difficult smoke management areas and to discuss ways to identify optimum weather conditions in the field. This is an important part of the meteorological program to make sure all coordinators and operational personnel, including farmers, are on the same page meteorologically. Possibly the 2017 burning season will allow a chance to visit more of these burning areas prior to, or during, the 2017 CRB season.

Burning Season Weather by Month in Brief:

August:

The 2016 CRB season began with full operational forecasts on August 1st, 2016. A pre-season meeting occurred with both local and remote staff on August 3rd. This served to establish daily expectations, goals, and to pre-emptively identify any potential issues with the current process. The first week of August saw a transition away from an upper level ridge pattern as an upper level low pressure system off Vancouver Island approached the Pacific Northwest (Figure 1). Ambient wildfire smoke would be a persistent hindrance to burning across many of the southern Idaho airsheds. The first week was no exception as active wildfires burned across eastern Oregon and within the west-central Boise National Forest. In addition to wildfire smoke, Red Flag Warnings issued by the NWS limited burning this week.

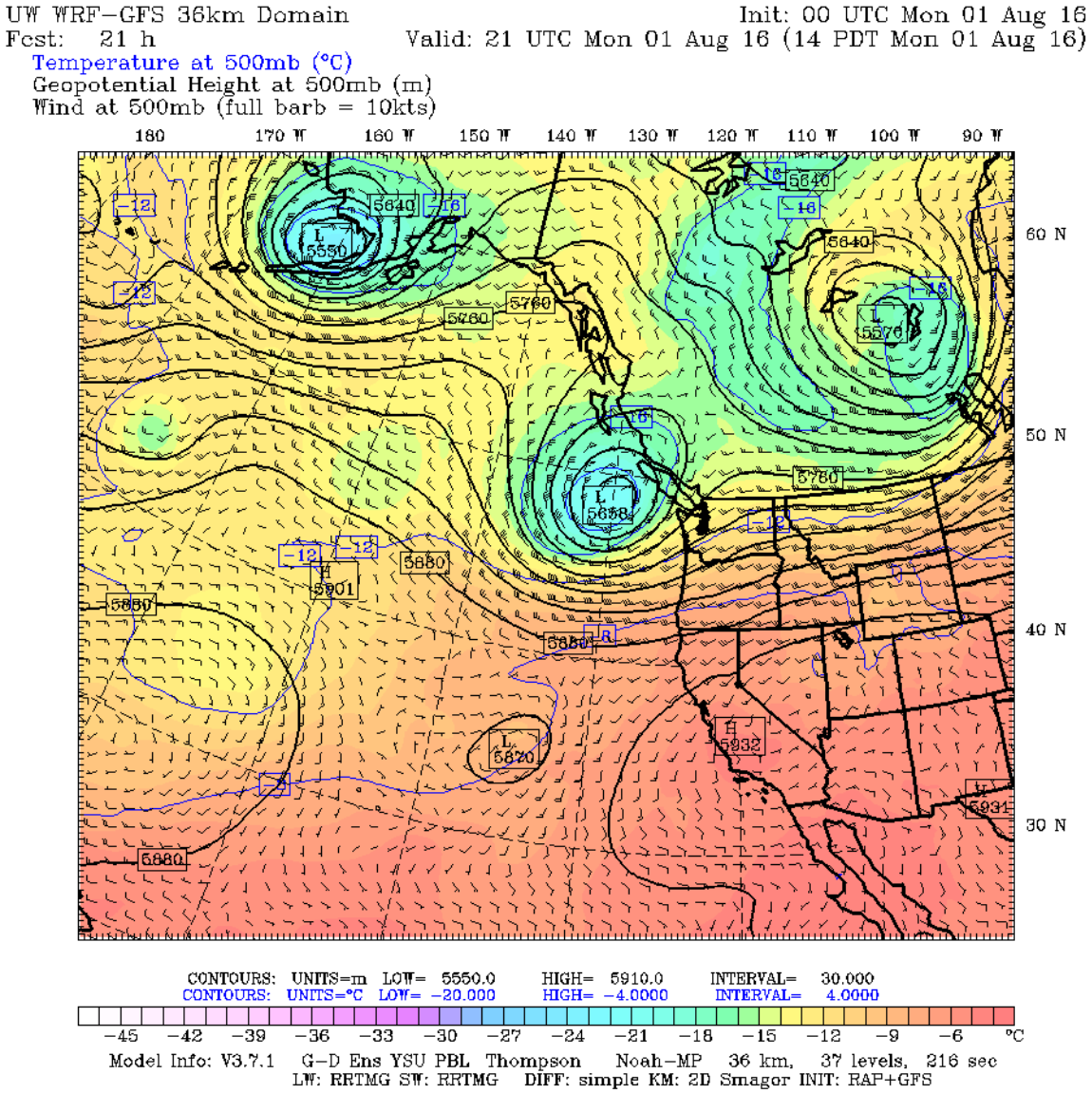

Figure 1: 500mb Temperature initialized 00Z 01 August 2016 and valid 21Z 01 August 2016.

By the second week of August, the upper level low pressure system had deepened and settled directly over central Washington (Figure 2). While not bringing much in the way of precipitation to southern Idaho, it did allow for a consistent southwesterly flow pattern to establish. Early in the week, local AQA's driven by ambient wildfire smoke and Red Flag Warnings limited burning but by Wednesday; conditions were optimal for burning across the southern Idaho landscape.

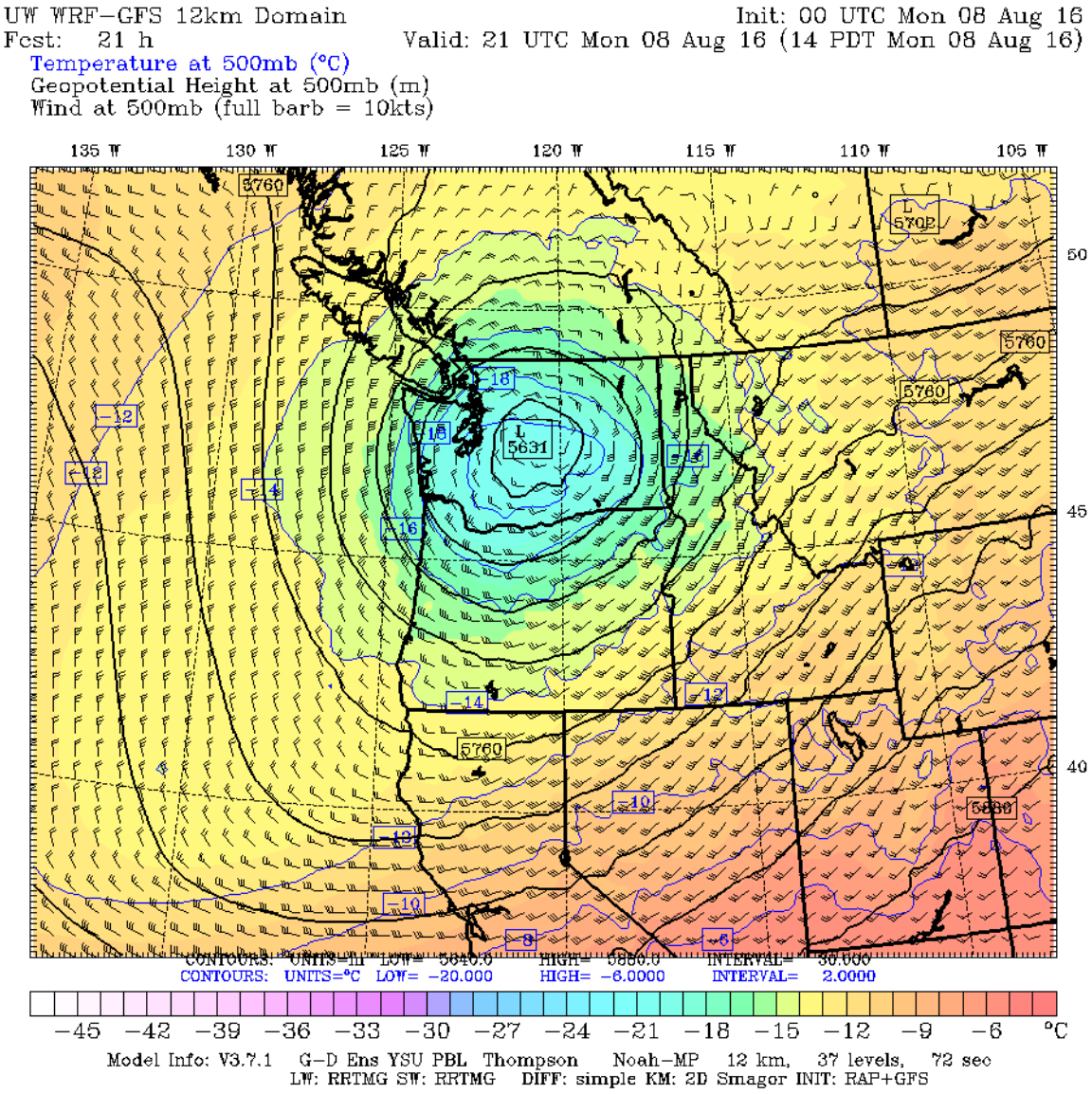

Figure 2: 500mb Temperature initialized 00Z 08 August 2016 and valid 21Z 08 August 2016.

Continued wildfire smoke drove the issuance of AQA's across parts of southern Idaho and shut down burning in those spots. Other threats during the third week included afternoon thunderstorms across eastern and southeast Idaho. The location of the 4-Corners high had shifted over much of the southwest and Pacific, thereby pushing monsoon moisture to the south-eastern portion of Idaho (Figure 3).

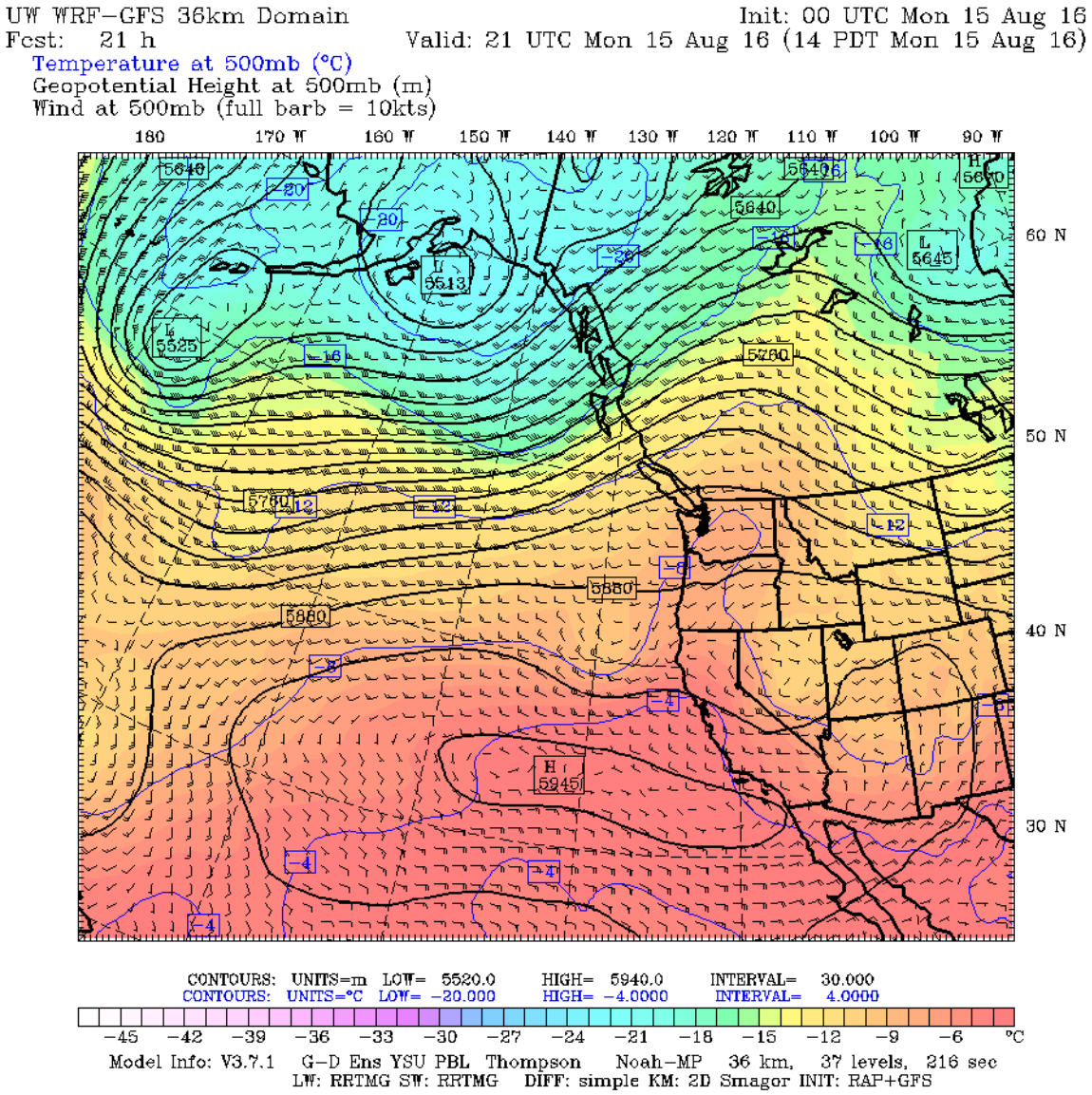

Figure 3: 500mb Temperature initialized 00Z 15 August 2016 and valid 21Z 15 August 2016.

An upper level low passing through southern Canada affected the weather across the southern Idaho landscape by bringing a tighter surface pressure gradient and the associated stronger surface winds (Figure 4). These strong winds, coupled with seasonably low relative humidity levels brought Red Flag Warnings early in the week, and due to the related increased fire activity on active wildfires, brought a new wave of AQA issuances. This also brought isolated thunderstorms to eastern Idaho which were dry in nature.

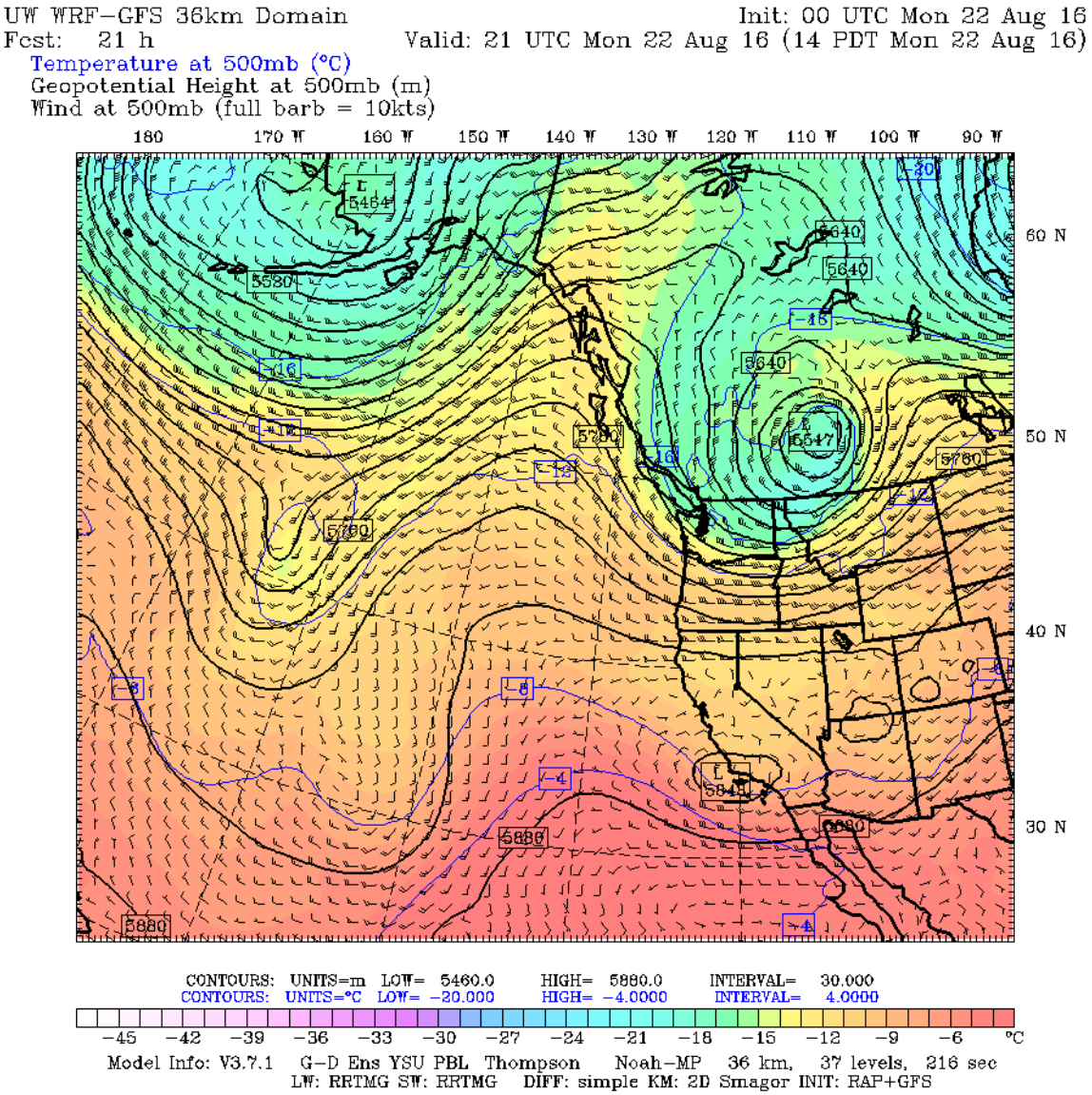

Figure 4: 500mb Temperature initialized 00Z 22 August 2016 and valid 21Z 22 August 2016.

The end of August and beginning of September saw a continued southwest steering pattern as a broad upper level low pressure system and associated secondary low pressure system brought moderate winds and a risk of eastern and southeastern air shed thunderstorms (Figure 5). Continued wildfire smoke affected local communities and impacted the ability to burn in those regions.

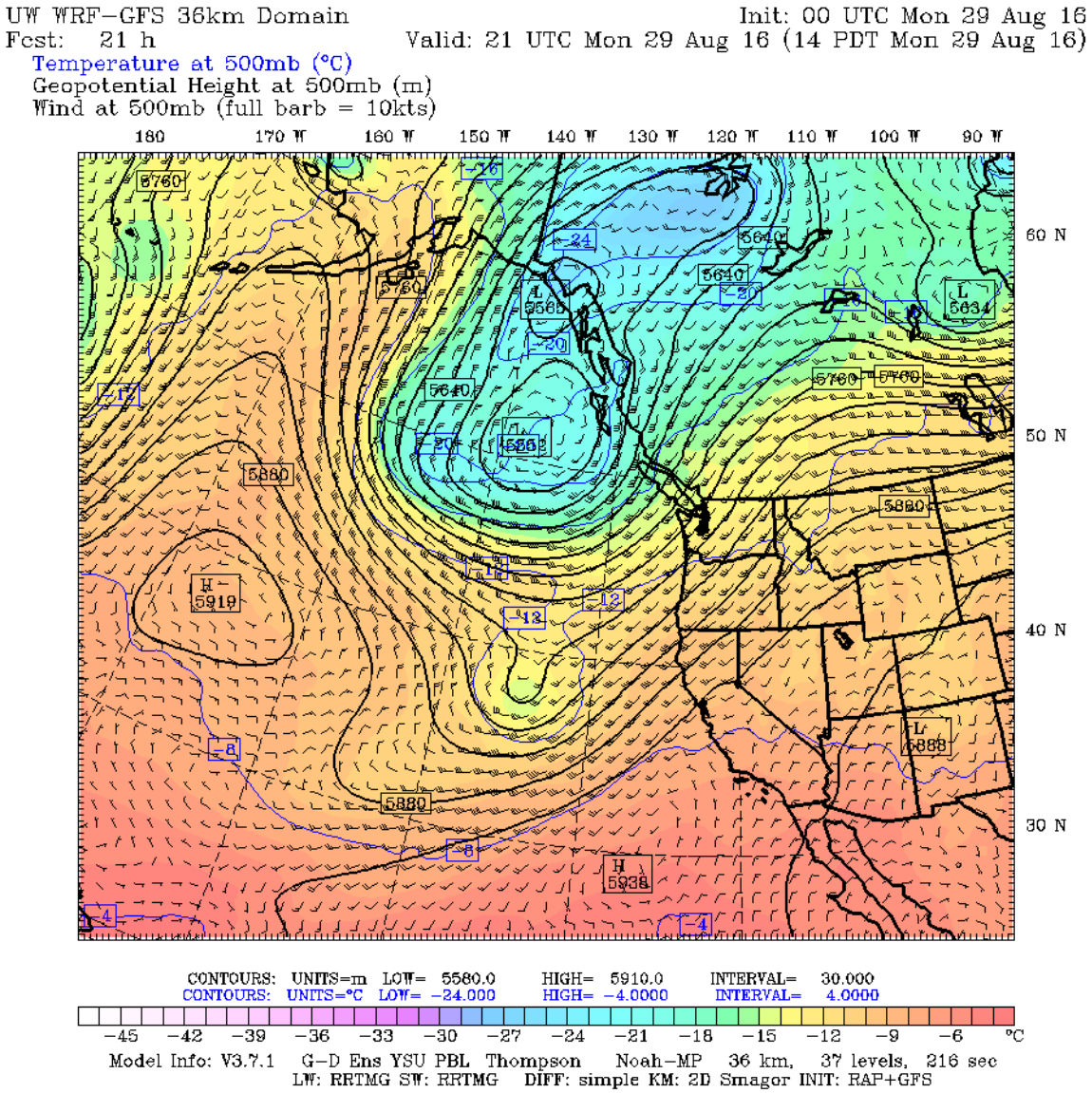

Figure 5: 500mb Temperature initialized 00Z 29 August 2016 and valid 21Z 29 August 2016.

A local high pressure system sat over northern Utah and extended over portions of southeast Idaho and western Wyoming. This drove sinking air along the northwest quadrant and into southwest Idaho where it was evident in the Ventilation Index which stayed in the Moderate to Poor category within the Lower Snake River Plain (Figure 6).

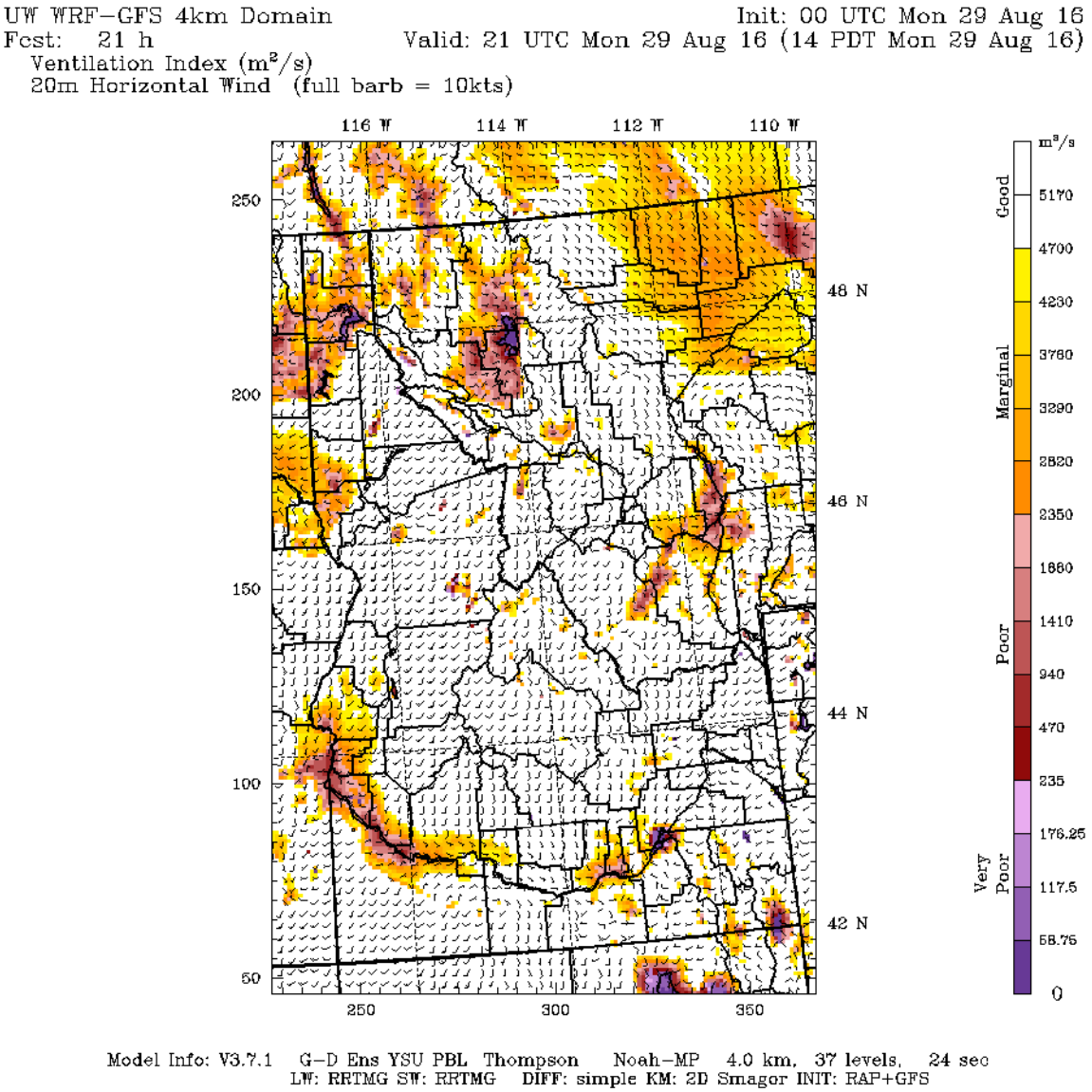

Figure 6: 4km Ventilation Index initialized 00Z 29 August 2016 and valid 21Z 29 August 2016.

September:

The first week of September saw a northwest flow pattern develop in the wake of weak upper level ridging over the Canadian Rockies (Figure 7). There were no major impacts on burning outside of the AQA's issued due to continued ambient wildfire smoke. Afternoon thunderstorms early in the week brought considerable precipitation to Burley (0.89") on the 4th; however, that was the only region heavily impacted while southeast and eastern Idaho received amounts under 0.10" and Boise recorded measurements of 0.01".

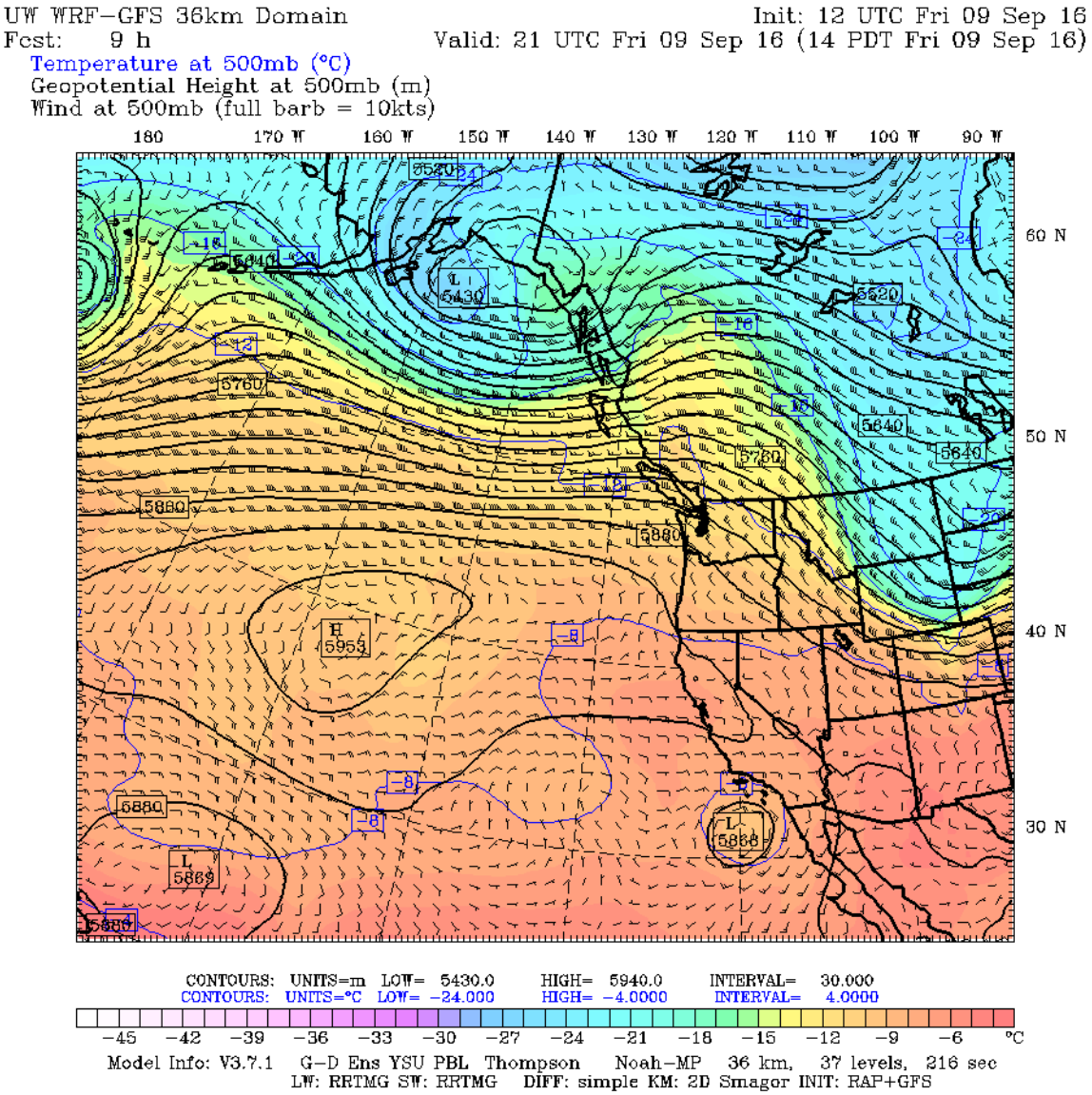

Figure 7: 500mb Temperature initialized 12Z 09 September 2016 and valid 21Z 09 September 2016.

The week of September 12th saw an elongated trough extend from northern California northeast into Manitoba, near Winnipeg. This system would strengthen; become closed, then cut off and retrograde through the week (Figure 8). This accounted for strong winds and a threat for precipitation for much of the week as southern Idaho sat along the leading edge of this trough axis. The latter portion of the week saw burning inhibited by high values of fuel and soil moisture.

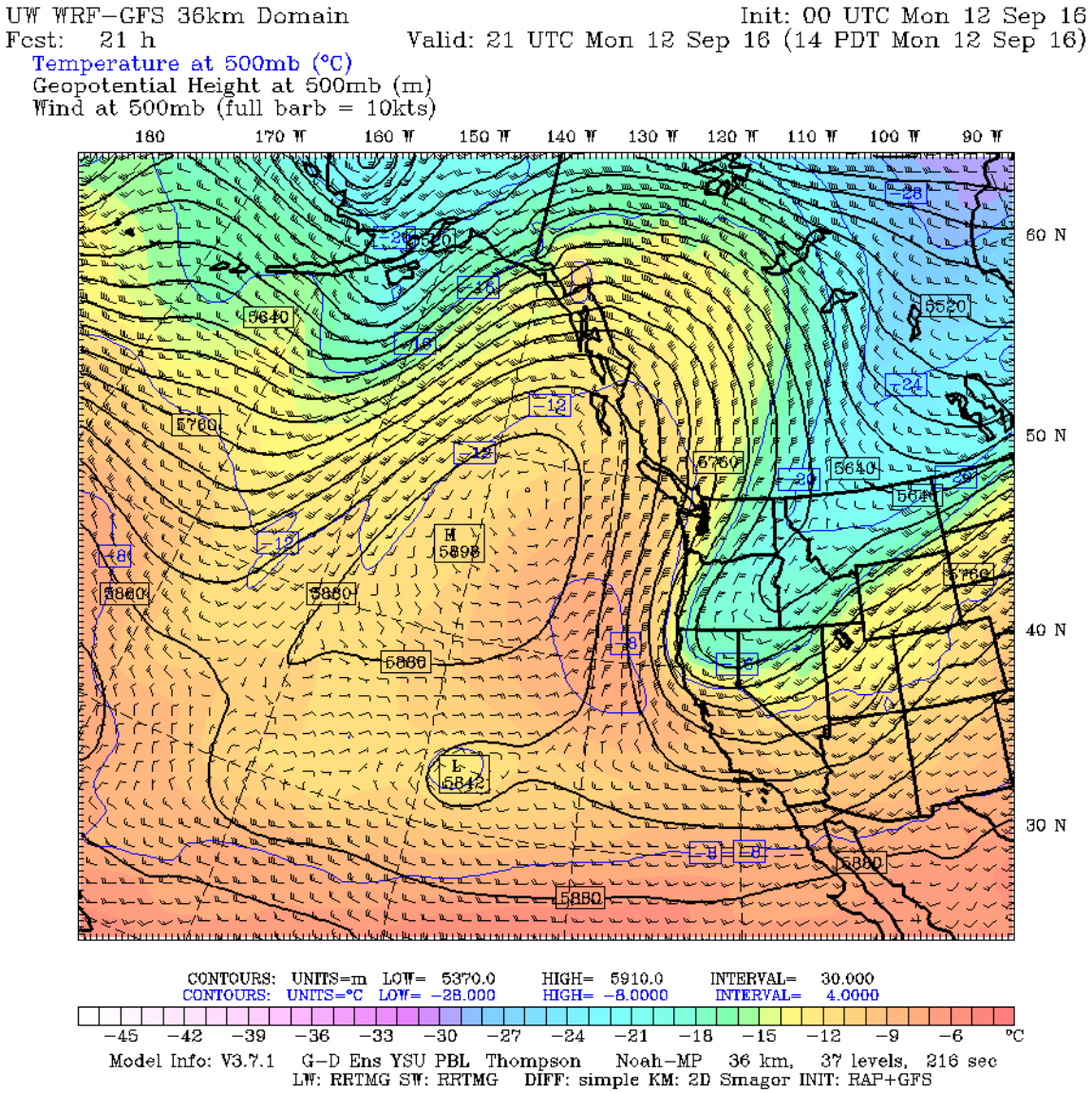

Figure 8: 500mb Temperature initialized 12Z 12 September 2016 and valid 21Z 12 September 2016.

By Friday, the trough axis had moved slightly to the south and sat directly through southeastern Idaho. Again, this brought plenty of late summer/early fall precipitation to the region (Figure 9) with most of the rain falling over the Magic Valley while Pocatello recorded 0.52" on the 14th.

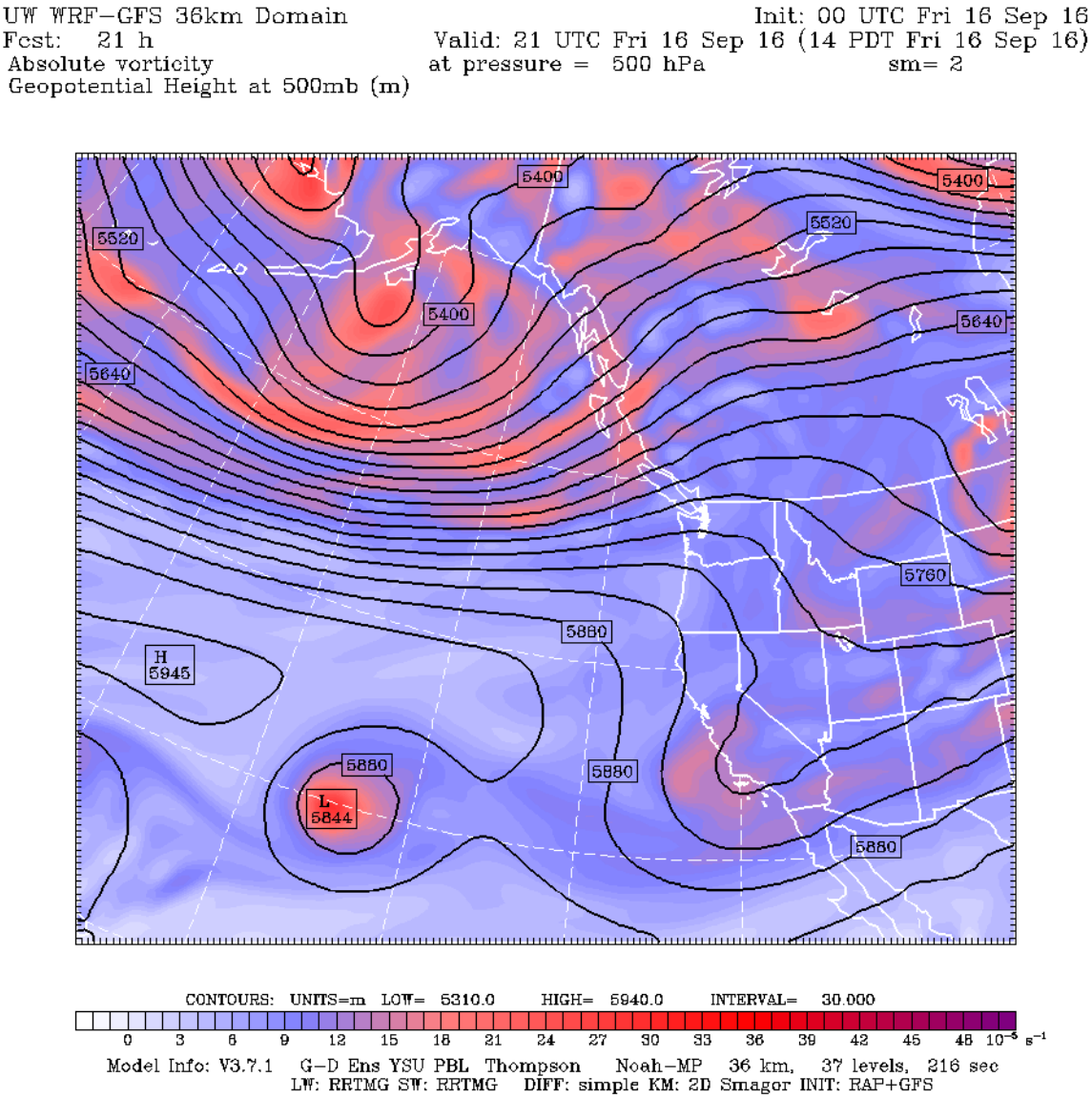

Figure 9: 500mb Vorticity initialized 00Z 16 September 2016 and valid 21Z 16 September 2016.

Further complicating matters was a persistent capping inversion within the Snake River Plain which accounted for Marginal to Poor dispersion characteristics within the Snake River Plain as evidenced in the Ventilation Index (Figure 10). This was driven by the sagging upper level trough and a slight ridge pattern moving in overhead.

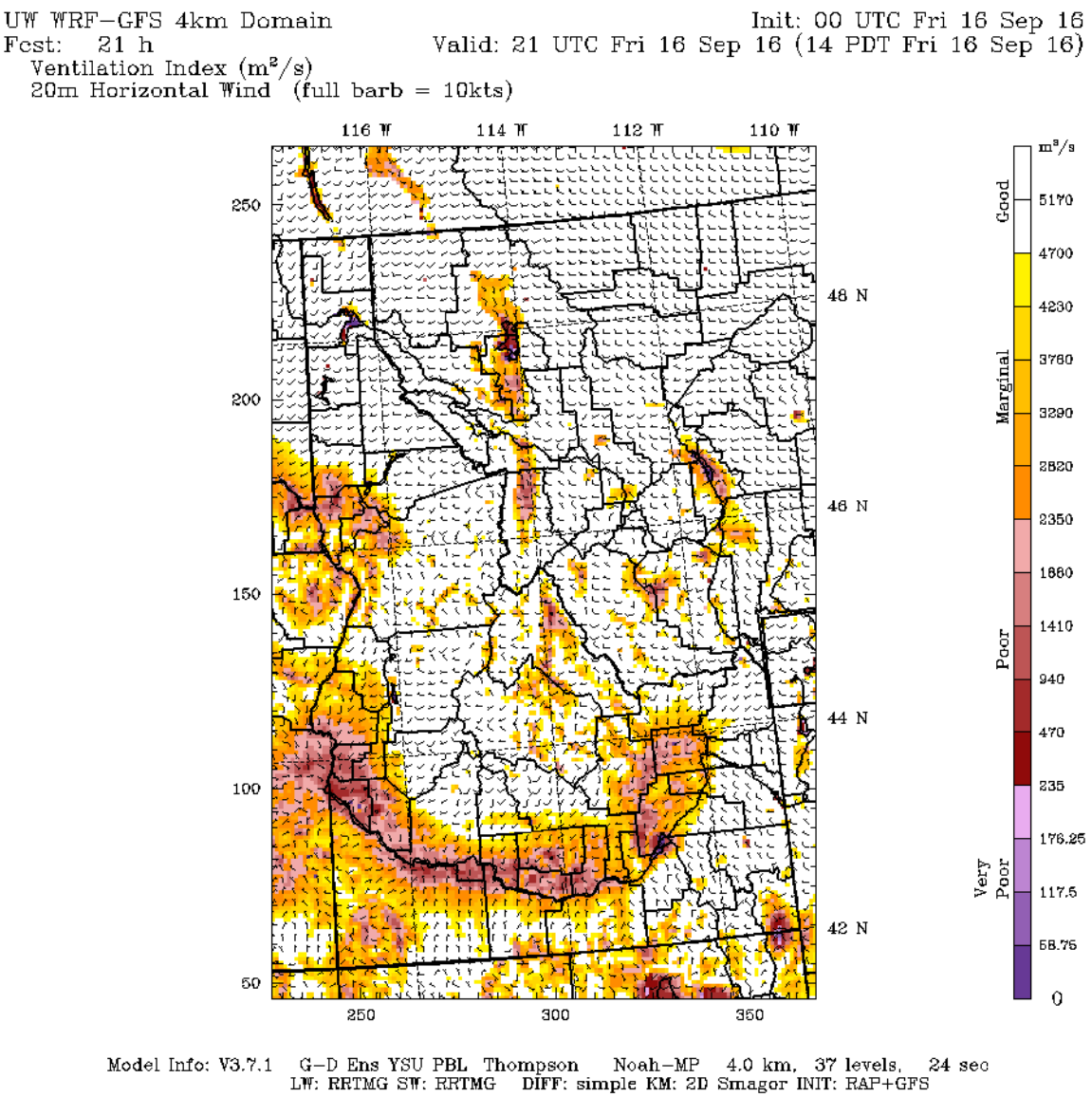

Figure 10: 4km Ventilation Index initialized 00Z 16 September 2016 and valid 21Z 16 September 2016.

As the upper level low pressure system became cut off (Figure 11), a zonal flow regime moved in. This allowed for any minor disturbance to drastically impact the local weather. This was well-documented in the latter part of the week with all areas receiving a wetting rain.

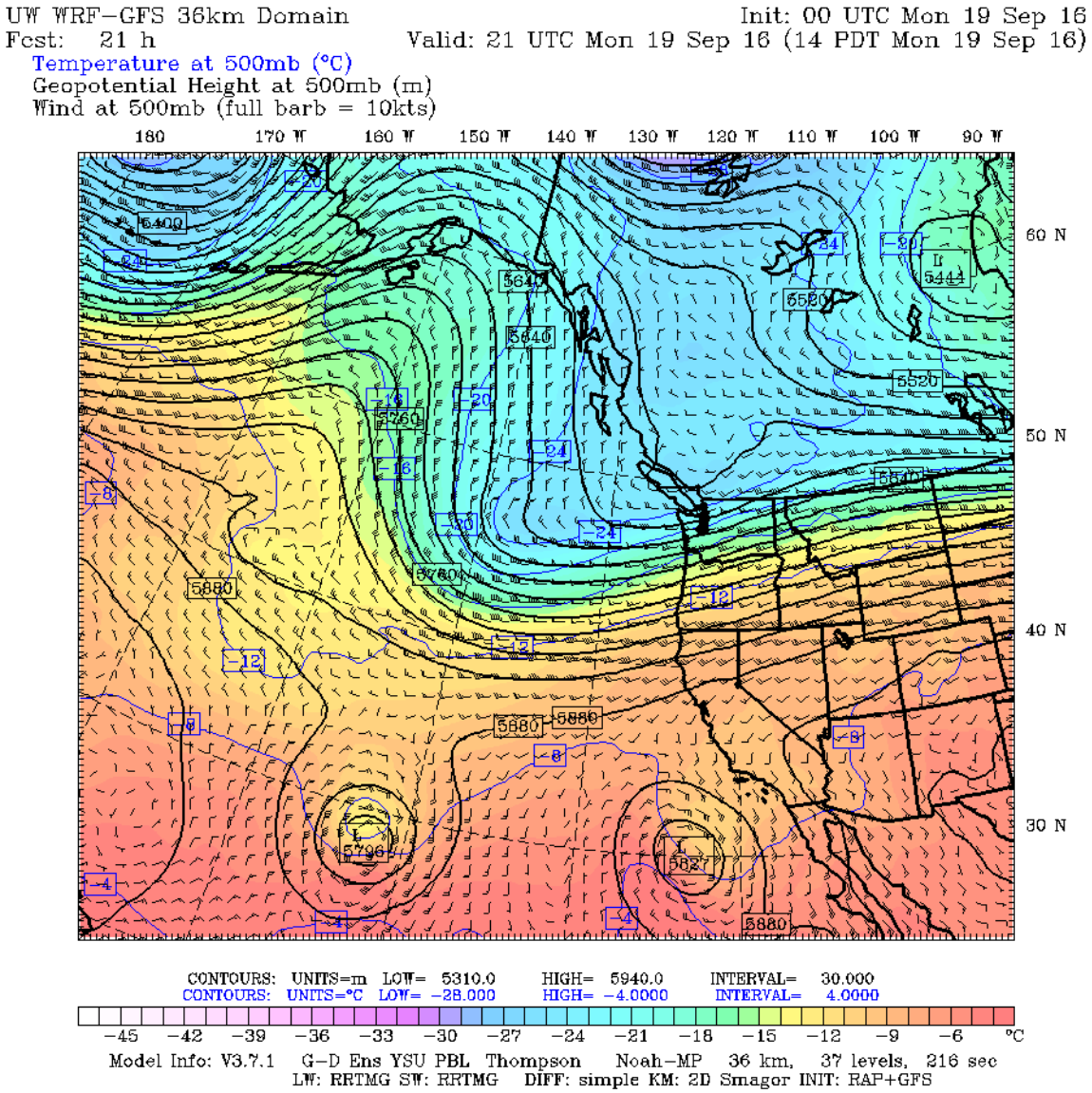

Figure 11: 500mb Temperature initialized 00Z 19 September 2016 and valid 21Z 19 September 2016.

By Friday September 23rd, southeast, eastern, and the Magic Valley had received 1-2" of precipitation to close out the week. This was due to the cut off low pressure system tracking to the east-northeast as it became absorbed within the mean flow (Figure 12). The center of the low was directly located over southeast Idaho and provided ample amounts of precipitation over the region.

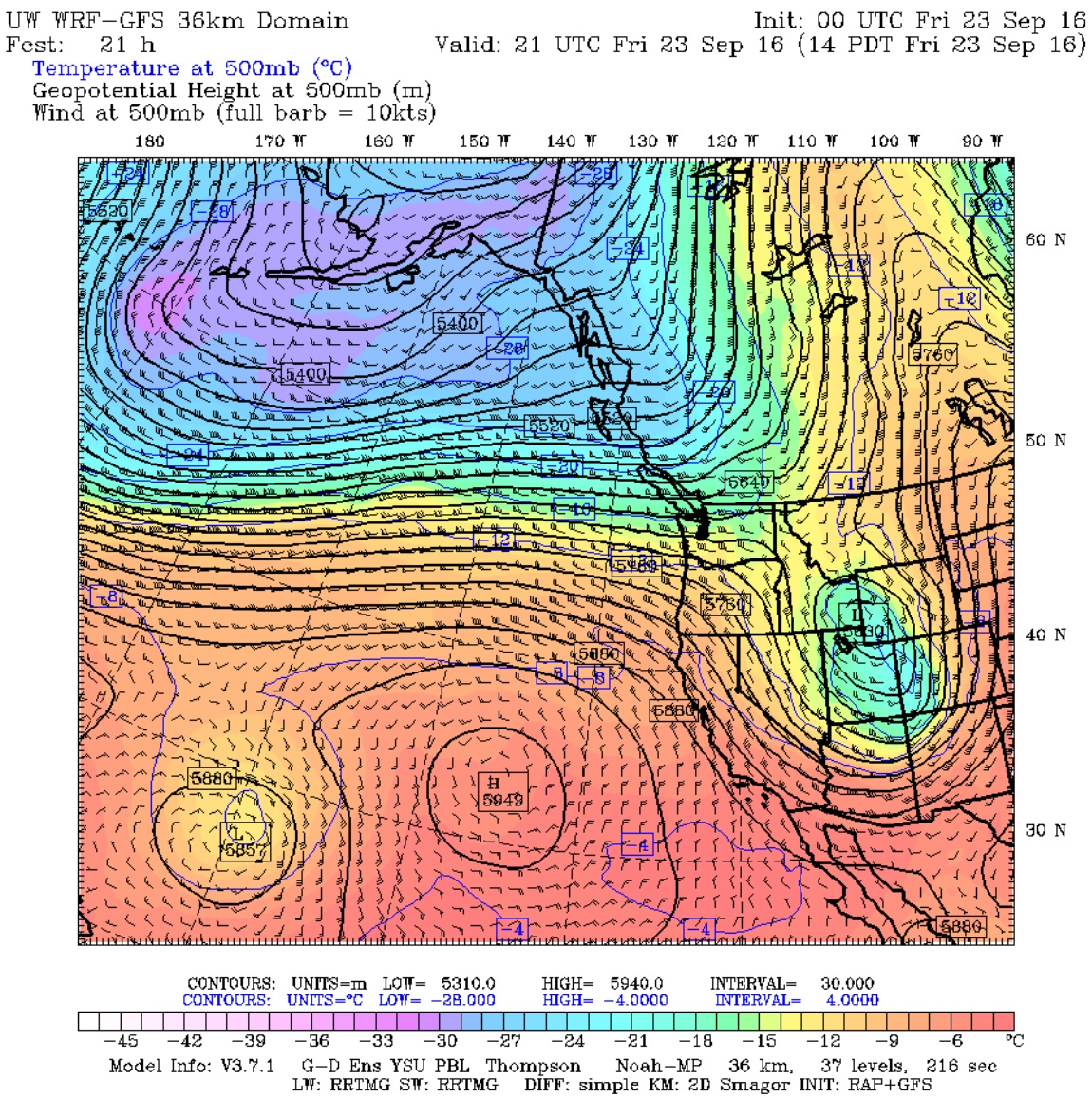

Figure 12: 500mb Temperature initialized 00Z 23 September 2016 and valid 21Z 23 September 2016.

The last week of September saw a mid-level high pressure system settle directly over southern Idaho (Figure 13). This generated consistent ventilation concerns for all of the southern Idaho air sheds.

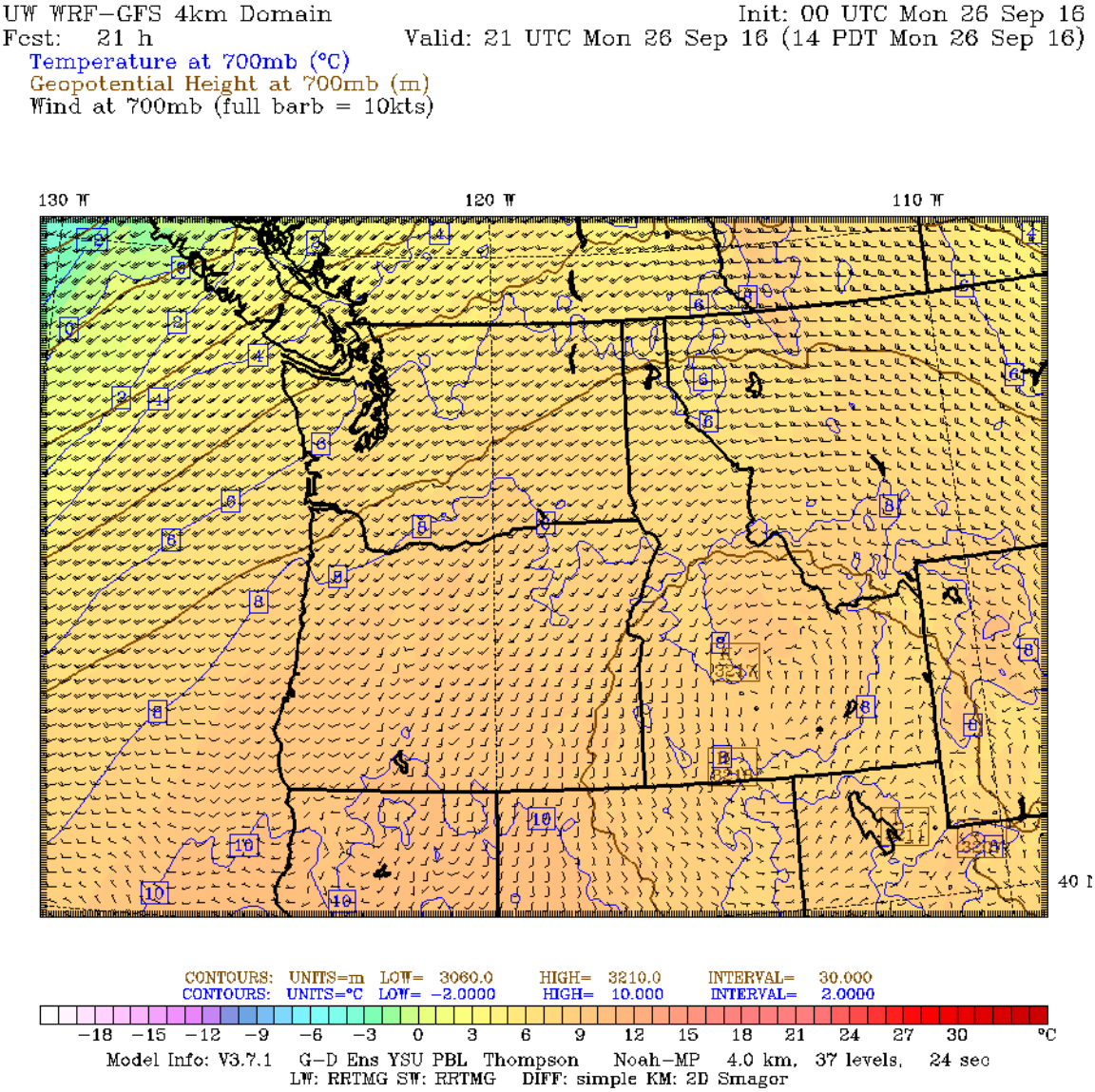

Figure 13: 700mb Temperature initialized 00Z 26 September 2016 and valid 21Z 26 September 2016.

As evidenced by Figure 14 (below), ventilation metrics indicated that dispersion would be quite poor over much of the Upper Snake River Plain and Marginal over most of the southern air sheds, portions of the southwest notwithstanding.

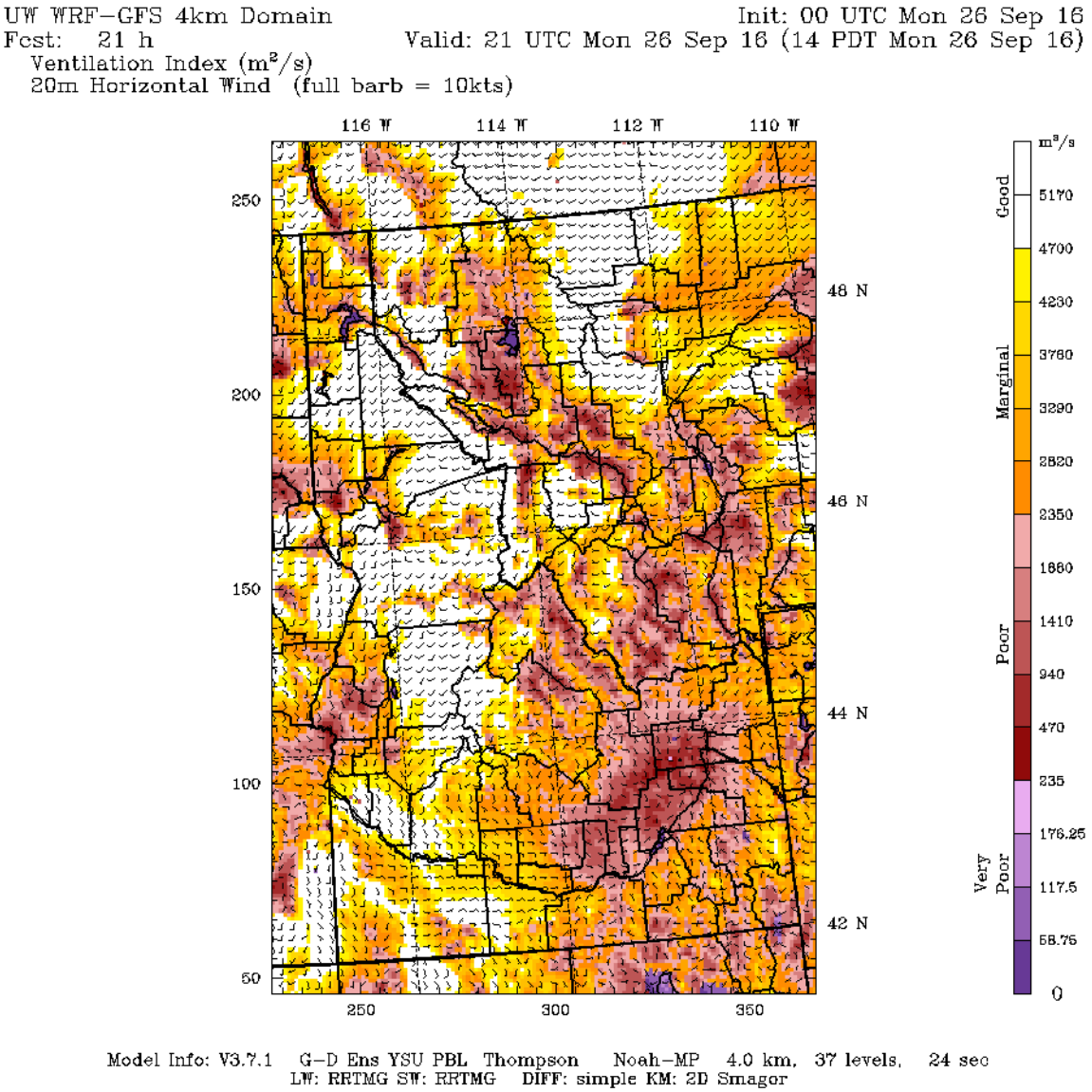

Figure 14: 4km Ventilation Index initialized 00Z 26 September 2016 and valid 21Z 26 September 2016.

The end of the week saw the ridge of high pressure vacate the region as a secondary upper level low pressure system and its parent (located nearly directly over Haida Gwaii) moved into the region (Figure 15). This would bring a trace of precipitation to all air sheds on the last day of the month.

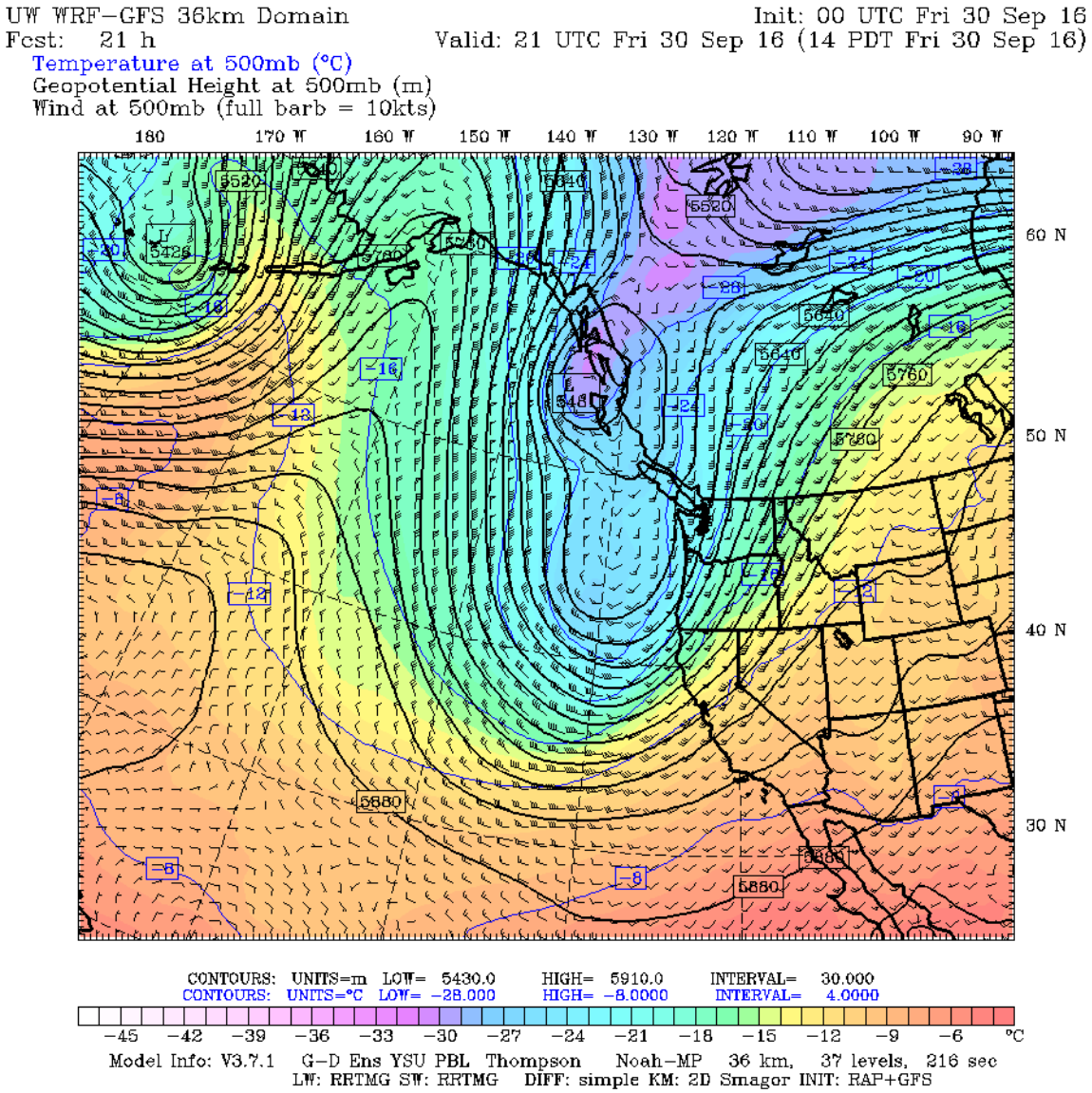

Figure 15: 500mb Temperature initialized 00Z 30 September 2016 and valid 21Z 30 September 2016.

October:

The first week of October brought a continued active weather pattern to the northern Idaho airsheds. An upper level low pressure system was located over southeast Idaho while an associated trough axis ran directly through central Idaho from Haida Gwaii. This led to the establishment of a complicated flow pattern with winds west of the axis flowing northwest, turning west-southwest over southeast and eastern Idaho (Figure 16).
This system brought precipitation to much of southern Idaho. Cooler temperatures, high wind speeds, and the aforementioned precipitation effectively limited any burning for the week.

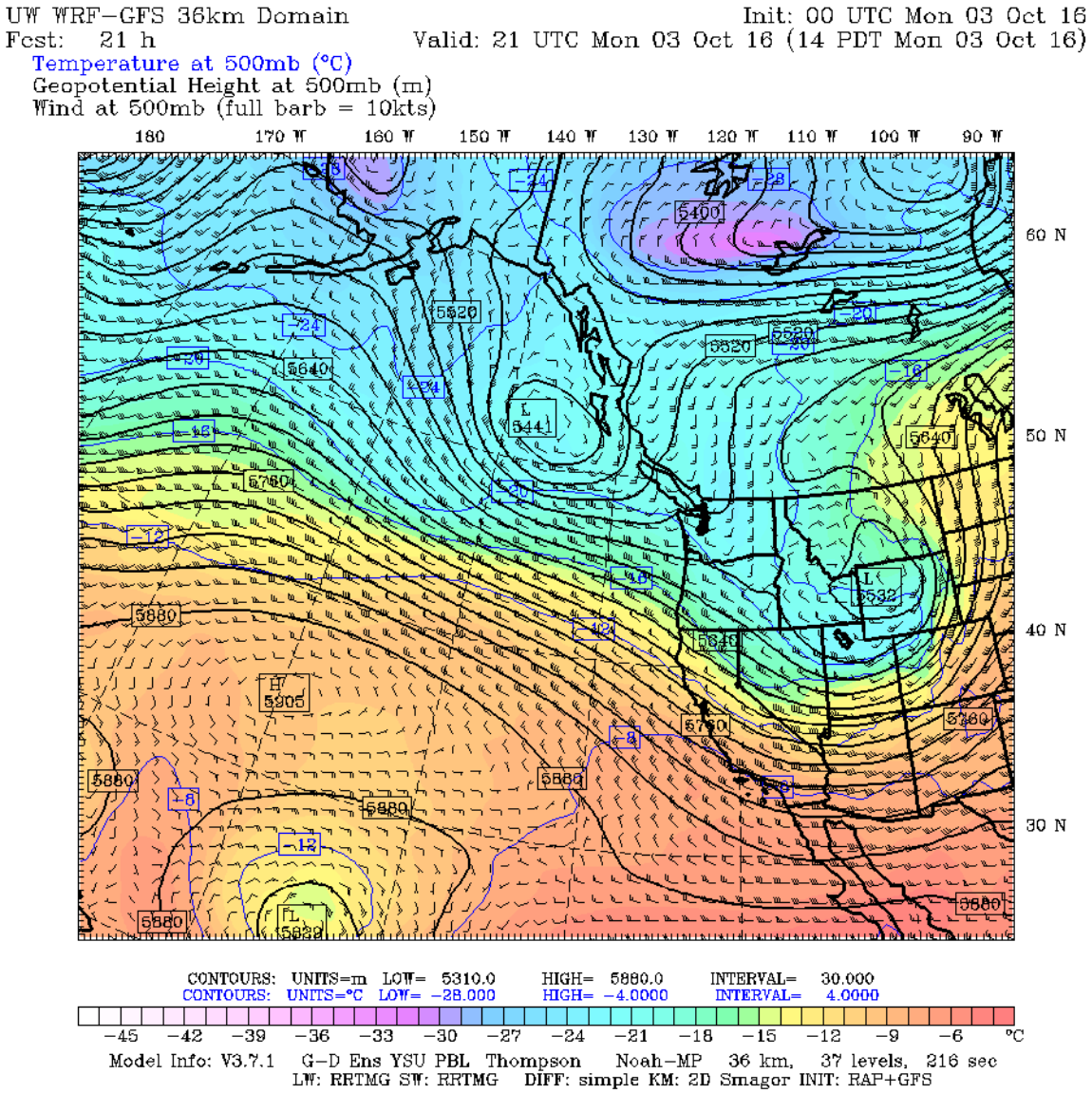

Figure 16: 500mb Temperature initialized 00Z 03 October 2016 and valid 21Z 03 October 2016.

By the end of the first week, the upper level low pressure system had moved to the east and a zonal flow pattern had established (Figure 17).

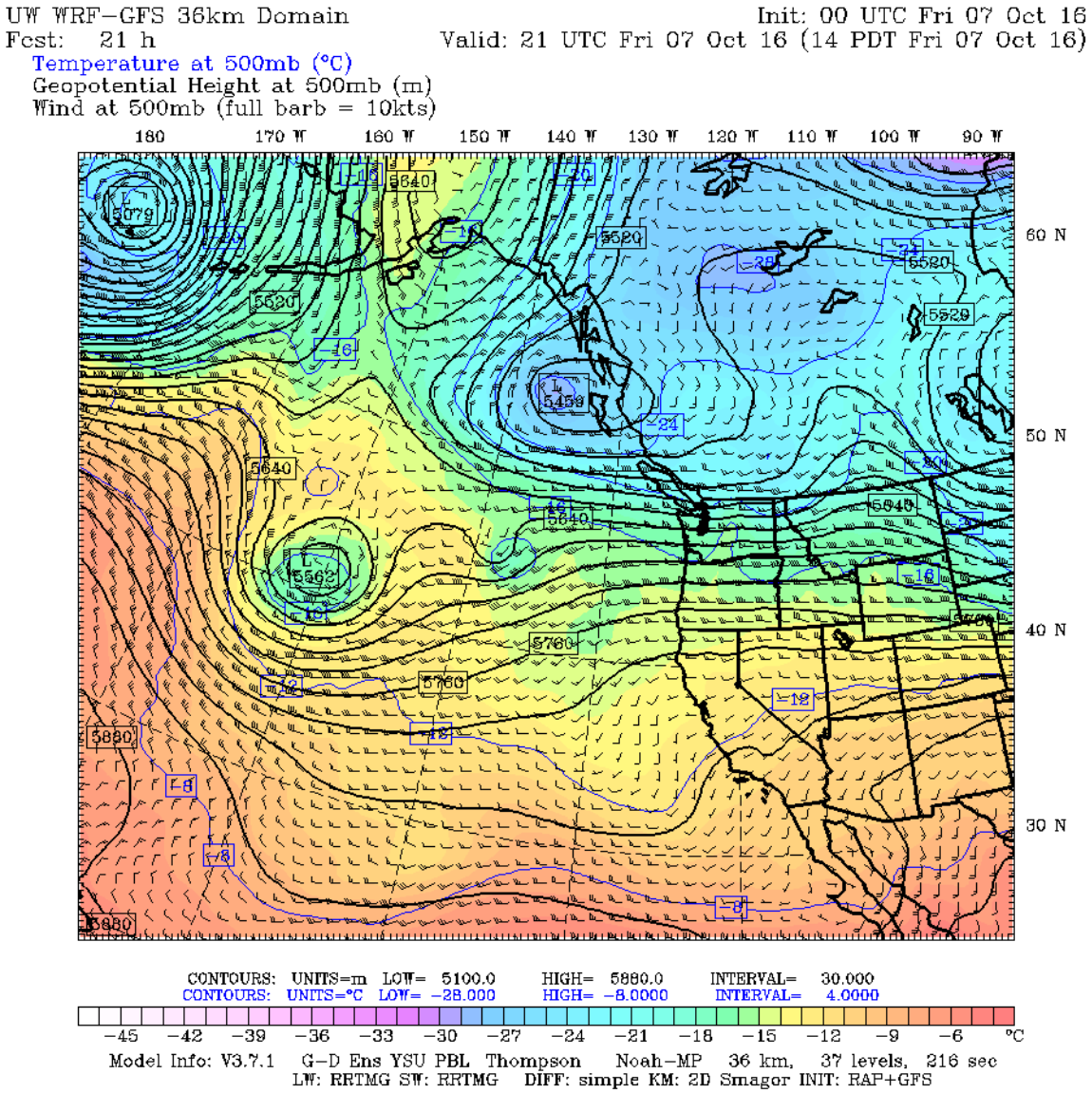

Figure 17: 500mb Temperature initialized 00Z 07 October 2016 and valid 21Z 09 October 2016.

An elongated upper level low pressure system extending from the Bering Sea to the eastern Pacific off the coast of Oregon forced a shortwave ridge along the immediate Pacific Coast which then promoted cold, continental polar air that extended into the northern regions of the southern Idaho air sheds early in the week (Figure 18). This brought strong winds (up to 46 mph) to south-central Idaho as well as 0.15" of precipitation over the week. Winds across the southwest were lower, albeit quite high for that area, reaching speeds in excess of 35 mph.

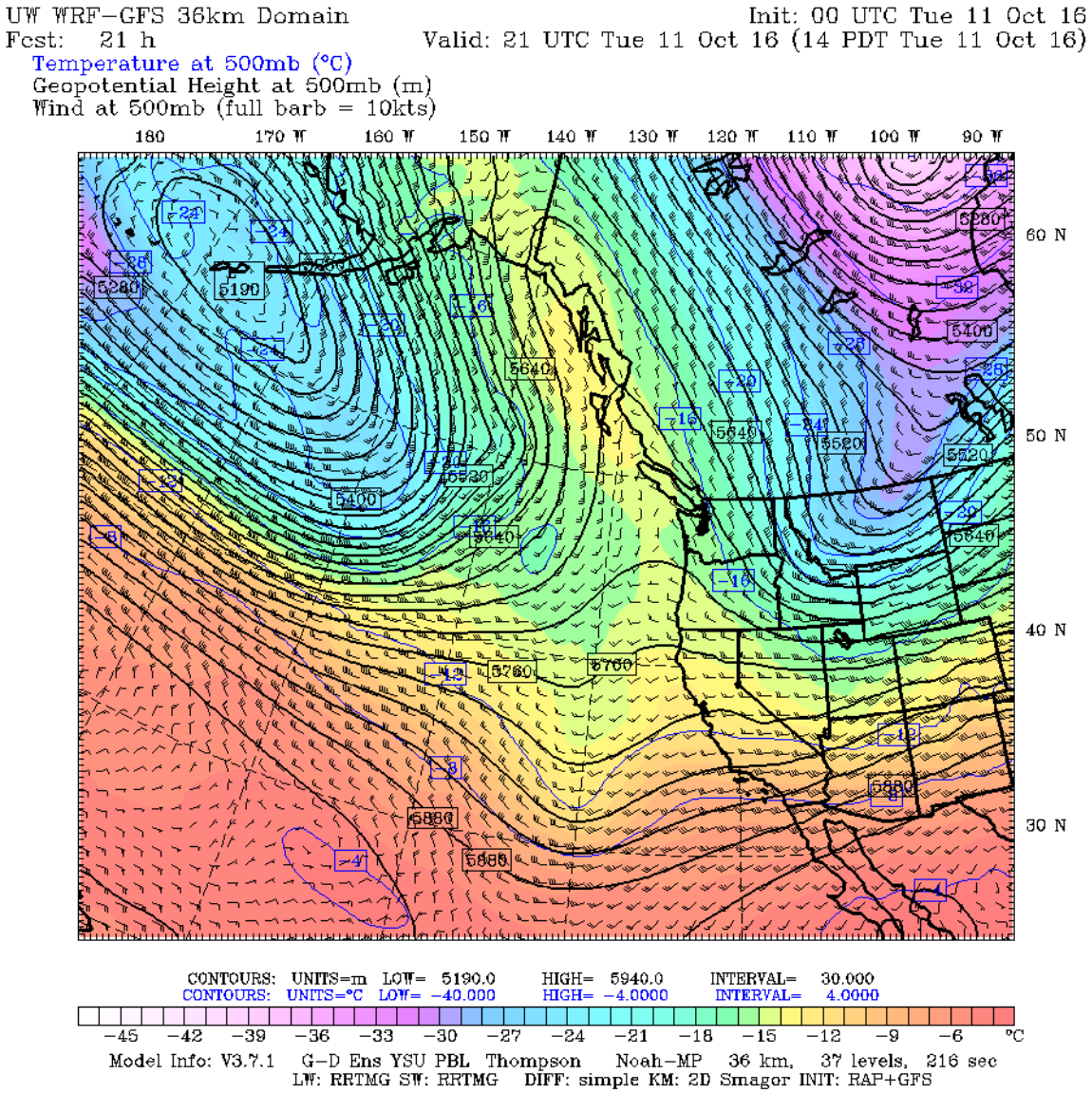

Figure 18: 500mb Temperature initialized 00Z 11 October 2016 and valid 21Z 11 October 2016.

As a zonal pattern developed through the week of the 17th, minor disturbances would impact southern Idaho burning operations with precipitation early in the week (Figure 19). Reductions in solar radiation would increase the amount of time needed to dry out soils and fuels for the remainder of the week. The latter half of this week contained some of the last dry days of the 2016 CRB Burning season.

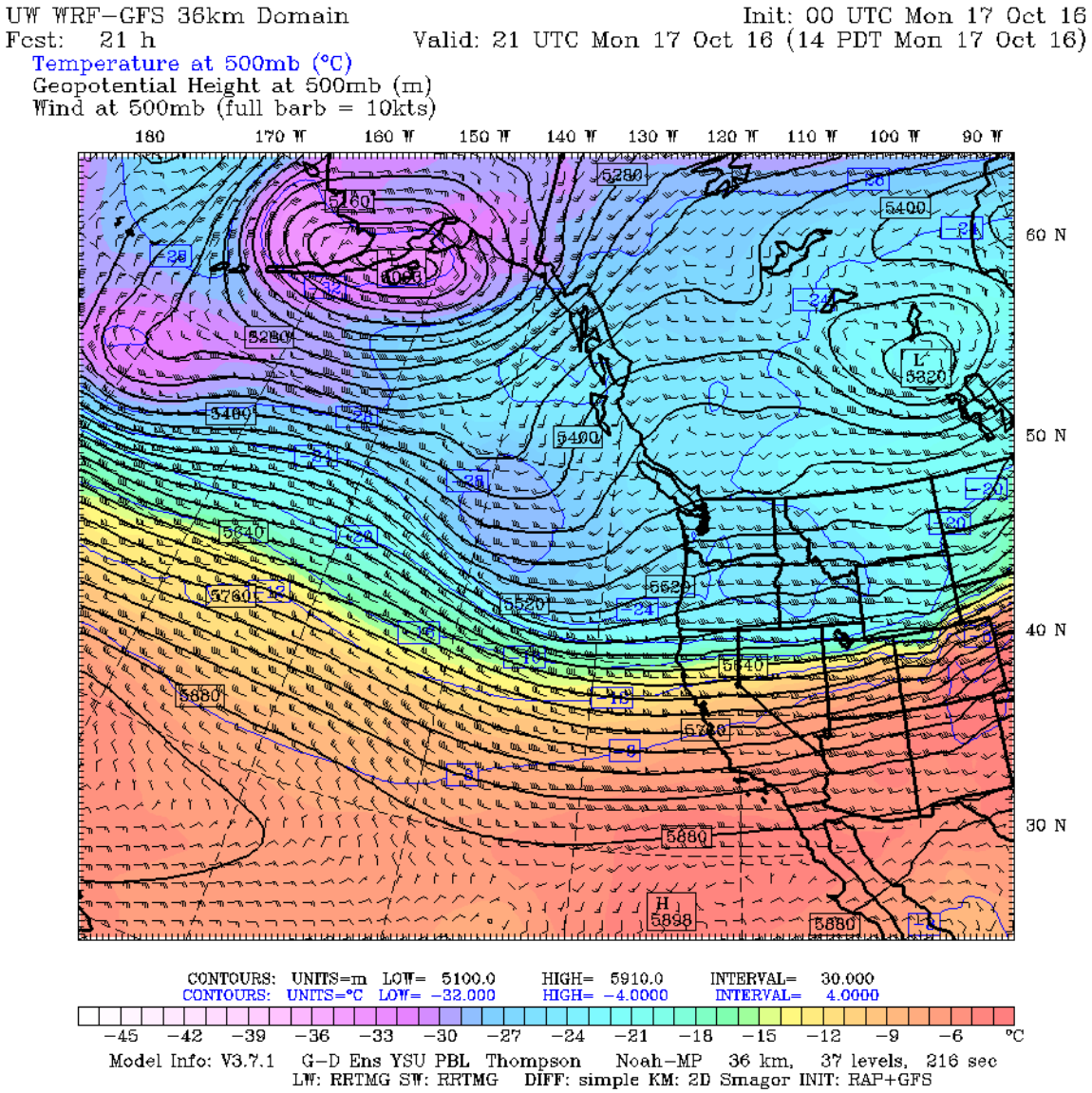

Figure 19: 500mb Temperatures initialized 00Z 17 October 2016 and valid 21Z 17 October 2016.

By the end of the week, the precipitation had ceased, but ventilation became a concern as stubborn morning inversions failed to fully mix out (Figure 20).

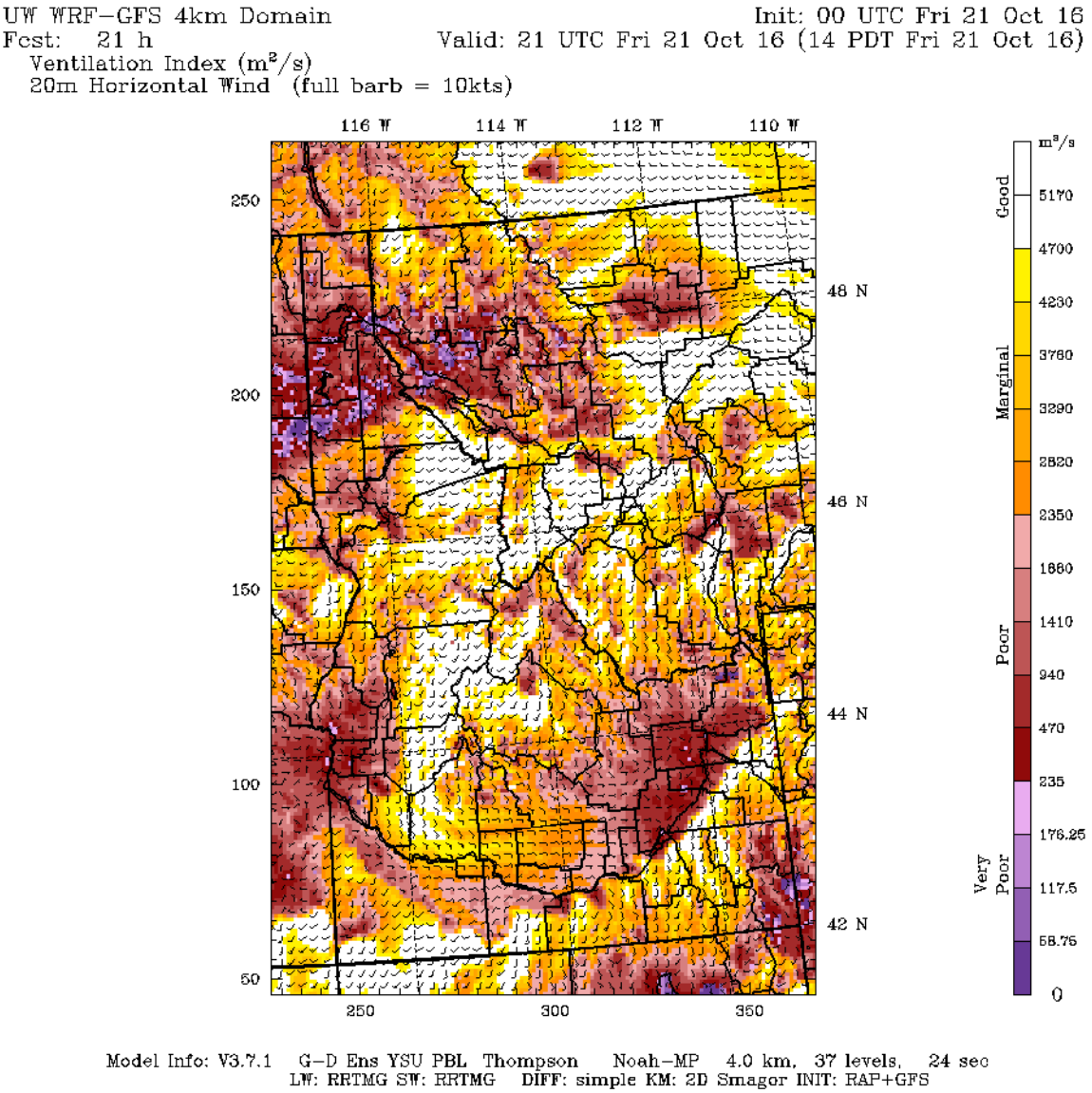

Figure 20: 4km Ventilation Index initialized 00Z 21 October 2016 and valid 21Z 21 October 2016.

The penultimate week of October began with the first winter storm approaching off the west coast of Washington with a strong upper level low (Figure 21). This system brought precipitation amounts of 1-1.5" except to the southwest, which saw about 0.2" of measurable precipitation. Winds were quite strong each day, ranging from 24-32 mph across the southwest, and 20-40 mph across the Middle and Upper Snake River Plain.

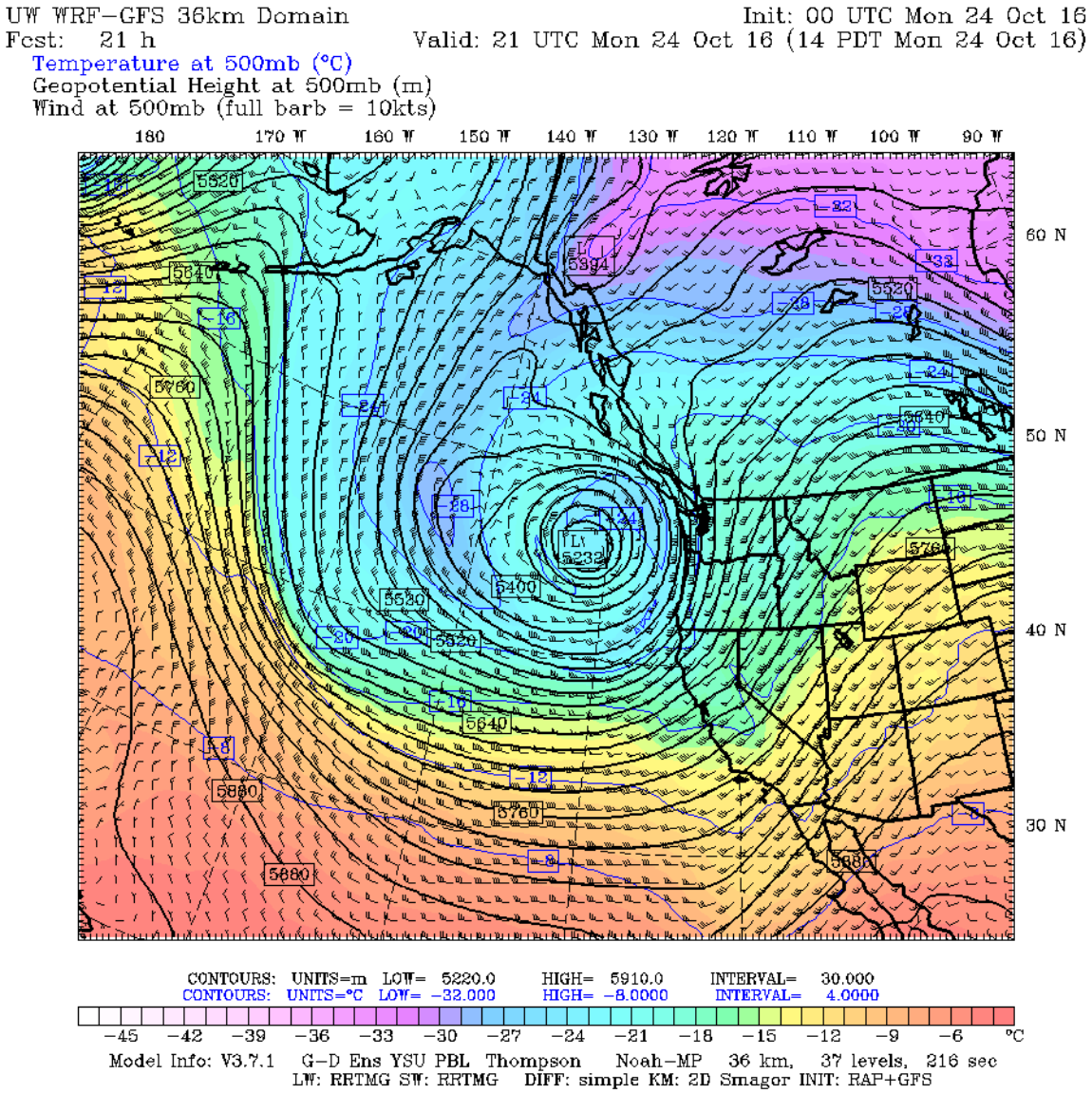

Figure 21: 500mb Temperature initialized 00Z 24 October 2016 and valid 21Z 24 October 2016.

. Ventilation and dispersion were of no concern across much of the Lower Snake and the only limiting factors were due to potentially strong pre-frontal winds as the system approached (Figure 22). This was not the case over the remainder of southern Idaho, where ventilation models indicated Poor to Marginal dispersion characteristics.

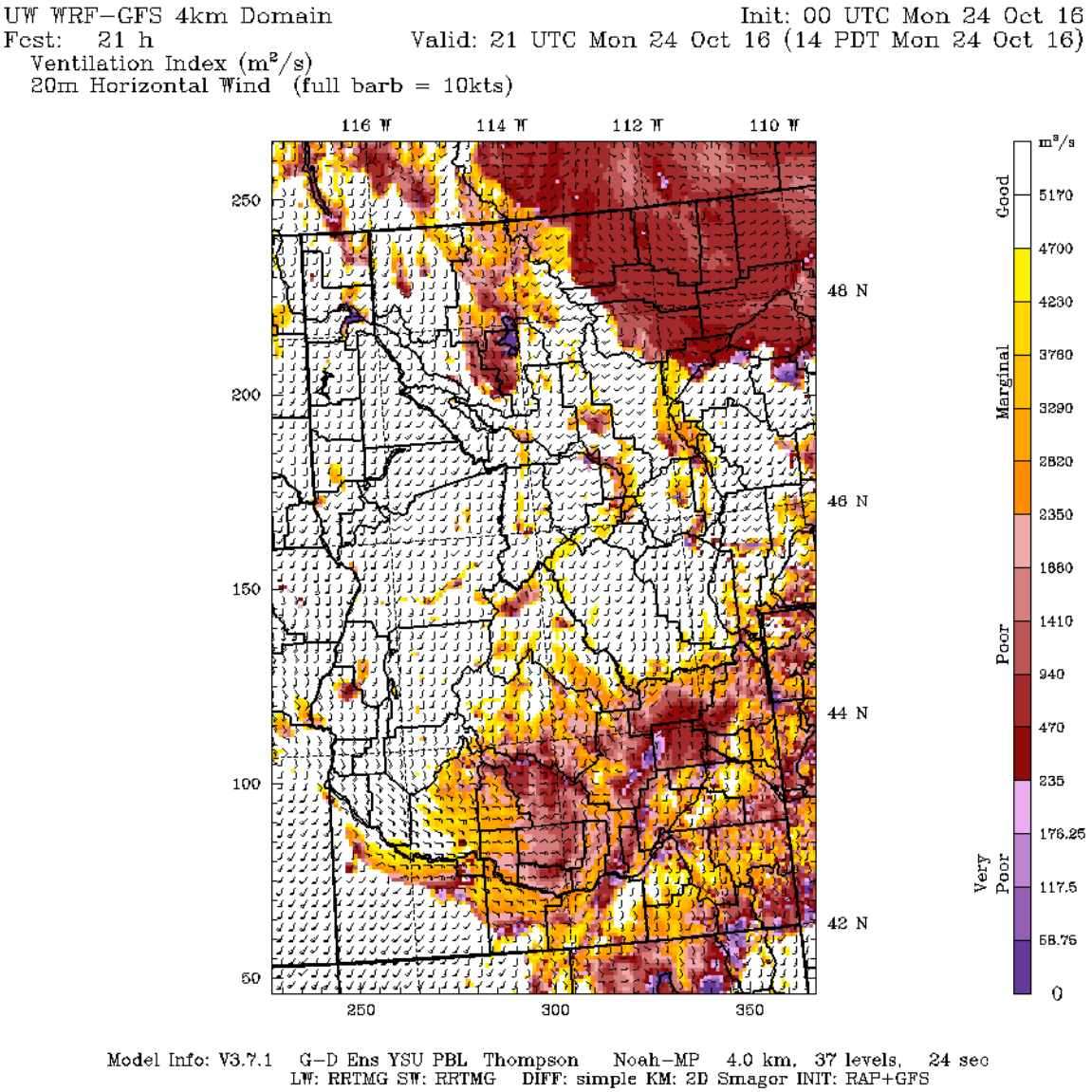

Figure 22: 4km Ventilation Index initialized 00Z 24 October 2016 and valid 21Z 24 October 2016.

This proved to be the last week of daily operational forecasts as the number of acres and requests reduced and the weather became increasingly ill-favored for burning.

Conclusion:

The 2016 agriculture field burning season was hampered at times by wildfire smoke, especially during the early portion of the season as fires burned across the Boise National Forest, and regional impacts from fires burning across the Clearwater air shed in central Idaho.

Model Performance:

Forecast weather models especially from the ARW-WRF and NAM-4km performed generally well during the 2016 CRB season but did struggle in the complex terrain regions of the

Southeast Highlands and near the Snake River in the Middle Snake River Plain. This required finer forecasting detail and was the most difficult task in daily operations. There exists a need to continue to improve the wind direction and speed forecasts. Field staff did note the increase in accuracy across the nuanced terrain of the Upper Snake River Plain on several occasions where specific wind conditions and burning techniques are necessary to complete the acres. There was 1 request for a Burn Day Analysis in southern Idaho this season. This was strictly due to a miscommunication between the grower and their staff which led to smoke over the road and a vehicle collision.

I will continue to train myself and field coordinators on southern Idaho weather patterns, especially localized wind patterns as well as any requests the regional office staff may have. This past post-season burn meeting in November contained 4 meteorological-based trainings and included cloud identification training and their associated impacts on burning.

Appendix B. Burn Decision Summary Table

Date	Acres	SMA
2/25/2016	115	Central
2/26/2016	60	Central
3/1/2016	70	Northern Magic Valley
3/2/2016	20	Southern Magic Valley
3/3/2016	3	Eastern Idaho
3/7/2016	20	Southwest Idaho
3/23/2016	12	Weiser & Lower Payette Valleys
3/25/2016	184	Southern Magic Valley
3/25/2016	13	Weiser & Lower Payette Valleys
3/30/2016	19	Central
3/31/2016	13	Central
4/1/2016	215	Boundary
4/1/2016	102	Central
4/6/2016	7	Southern Magic Valley
4/7/2016	135	Central
4/7/2016	21	Eastern Idaho
4/7/2016	199.5	Southeast Idaho
4/8/2016	2	Eastern Idaho
4/8/2016	362	Southeast Idaho
4/8/2016	106	Southern Magic Valley
4/11/2016	200	Boundary
4/11/2016	93	Central
4/11/2016	10	Southeast Idaho
4/12/2016	50	Eastern Idaho
4/18/2016	102	Boundary
4/18/2016	118	Central
4/18/2016	154	Eastern Idaho
4/18/2016	38	Southern Magic Valley
4/19/2016	199	Eastern Idaho
4/19/2016	72	Southeast Idaho
4/19/2016	27	Southern Magic Valley
4/20/2016	160	Boundary
4/21/2016	130	Southeast Idaho
4/27/2016	497	Eastern Idaho
4/28/2016	200	Eastern Idaho

Date	Acres	SMA
4/29/2016	366	Eastern Idaho
5/2/2016	6	Southeast Idaho
5/3/2016	35	Central
5/3/2016	47	Eastern Idaho
5/4/2016	4	Eastern Idaho
5/4/2016	2	Southeast Idaho
5/12/2016	135	Central
5/13/2016	190	Southeast Idaho
5/18/2016	105	Southeast Idaho
5/31/2016	55	Southeast Idaho
6/1/2016	150	Southeast Idaho
6/8/2016	36	Southwest Idaho
6/13/2016	3	Northern Magic Valley
6/13/2016	2	Southwest Idaho
6/17/2016	3	Southwest Idaho
6/21/2016	1	Southwest Idaho
7/1/2016	4	Central
7/7/2016	71	Northern Magic Valley
7/14/2016	43	Northern Magic Valley
7/15/2016	1	Central
7/20/2016	26	Southern Magic Valley
7/21/2016	142	Northern Magic Valley
7/21/2016	38	Southwest Idaho
7/25/2015	72	Southern Magic Valley
7/26/2016	11	Southwest Idaho
7/28/2016	100	Central
7/29/2016	74	Southern Magic Valley
7/29/2016	38	Southwest Idaho
8/1/2016	80	Weiser & Lower Payette Valleys
8/3/2016	15	Southwest Idaho
8/3/2016	12	Weiser & Lower Payette Valleys
8/4/2016	90	Central
8/4/2016	252	Northern Magic Valley
8/4/2016	165	Southern Magic Valley
8/4/2016	50	Southwest Idaho
8/8/2016	346	Northern Magic Valley
8/8/2016	41	Southern Magic Valley

Date	Acres	SMA
8/10/2016	80	Eastern Idaho
8/10/2016	389	Northern Magic Valley
8/10/2016	209	Southern Magic Valley
8/10/2016	10	Weiser & Lower Payette Valleys
8/11/2016	191	Eastern Idaho
8/11/2016	61	Northern Magic Valley
8/12/2016	54	Central
8/12/2016	297	Northern Magic Valley
8/12/2016	36	Southern Magic Valley
8/15/2016	240	Eastern Idaho
8/17/2016	71	Boundary
8/18/2016	473	Boundary
8/19/2016	269	Northern Magic Valley
8/19/2016	645	Southern Magic Valley
8/19/2016	98	Southwest Idaho
8/23/2016	89	Central
8/23/2016	398	Eastern Idaho
8/23/2016	115	Northern Magic Valley
8/23/2016	777	Southern Magic Valley
8/23/2016	47	Southwest Idaho
8/23/2016	19	Weiser & Lower Payette Valleys
8/24/2016	25	Blaine & Camas Counties
8/24/2016	55	Boundary
8/24/2016	2	Central
8/24/2016	95	Kootenai
8/24/2016	339	Northern Magic Valley
8/24/2016	270	Southeast Idaho
8/24/2016	130	Southern Magic Valley
8/25/2016	110	Blaine & Camas Counties
8/25/2016	149	Boundary
8/25/2016	400	Central
8/25/2016	20	Eastern Idaho
8/25/2016	325	Northern Magic Valley
8/25/2016	81	Southern Magic Valley
8/25/2016	57	Southwest Idaho
8/25/2016	23	Weiser & Lower Payette Valleys
8/26/2016	154	Blaine & Camas Counties

Date	Acres	SMA
8/26/2016	40	Boundary
8/26/2016	296	Central
8/26/2016	100	Eastern Idaho
8/26/2016	38	Northern Magic Valley
8/26/2016	18	Southern Magic Valley
8/29/2016	65	Boundary
8/29/2016	714	Central
8/29/2016	13	Eastern Idaho
8/29/2016	220	Northern Magic Valley
8/29/2016	250	Southern Magic Valley
8/29/2016	51	Southwest Idaho
8/31/2013	79	Boundary
9/1/2016	283.6	Central
9/1/2016	108	Northern Magic Valley
9/1/2016	437	Southeast Idaho
9/1/2016	163	Southwest Idaho
9/2/2016	52	Southwest Idaho
9/6/2016	652	Eastern Idaho
9/6/2016	32	Southern Magic Valley
9/6/2016	82	Southwest Idaho
9/7/2016	179	Eastern Idaho
9/7/2016	1	Northern Magic Valley
9/7/2016	755	Southeast Idaho
9/7/2016	56	Southern Magic Valley
9/7/2016	19	Southwest Idaho
9/8/2016	1949	Central
9/9/2016	343	Central
9/9/2016	1081	Eastern Idaho
9/9/2016	220	Southeast Idaho
9/12/2016	210	Boundary
9/12/2016	606	Central
9/12/2016	192	Northern Magic Valley
9/12/2016	160	Southeast Idaho
9/12/2016	10	Southern Magic Valley
9/12/2016	15	Southwest Idaho
9/13/2016	80	Boundary
9/13/2016	823	Central

Date	Acres	SMA
9/13/2016	100	Eastern Idaho
9/14/2016	1651	Central
9/14/2016	23	Southwest Idaho
9/15/2016	110	Boundary
9/15/2016	693	Central
9/15/2016	56	Southwest Idaho
9/16/2016	234	Boundary
9/16/2016	388	Central
9/16/2016	193	Eastern Idaho
9/16/2016	16	Southern Magic Valley
9/19/2016	543	Central
9/19/2016	473.5	Eastern Idaho
9/19/2016	239	Southeast Idaho
9/19/2016	6	Southwest Idaho
9/20/2016	1310	Central
9/20/2016	274	Southeast Idaho
9/21/2016	438	Boundary
9/21/2016	677	Eastern Idaho
9/21/2016	147	Southeast Idaho
9/23/2016	149	Central
9/26/2016	162	Central
9/26/2016	15	Southwest Idaho
9/27/2016	60	Boundary
9/27/2016	976.5	Central
9/28/2016	233	Eastern Idaho
9/28/2016	20	Southeast Idaho
9/29/2016	248	Central
9/29/2016	77	Eastern Idaho
9/29/2016	30	Southeast Idaho
9/29/2016	66	Southern Magic Valley
9/29/2016	65	Weiser & Lower Payette Valleys
9/30/2016	425	Boundary
9/30/2016	347	Central
9/30/2016	55	Eastern Idaho
9/30/2016	4.5	Southeast Idaho
10/3/2016	364	Boundary
10/3/2016	240	Central

Date	Acres	SMA
10/6/2016	144	Central
10/11/2016	485.4	Central
10/11/2016	100	Southeast Idaho
10/12/2016	642	Central
10/12/2016	410	Eastern Idaho
10/12/2016	12	Northern Magic Valley
10/12/2016	310	Southeast Idaho
10/13/2016	5	Northern Magic Valley
10/13/2016	400	Southeast Idaho
10/13/2016	1	Southern Magic Valley
10/20/2016	100	Southeast Idaho
10/21/2016	20	Eastern Idaho
10/21/2016	675	Southeast Idaho
10/24/2016	81	Central
10/26/2016	75	Eastern Idaho
10/27/2016	18	Eastern Idaho
10/27/2016	430	Southeast Idaho
10/27/2016	18	Southern Magic Valley
11/2/2016	3	Central
11/3/2016	27	Weiser & Lower Payette Valleys
11/4/2016	101	Central
11/4/2016	30	Southeast Idaho
11/4/2016	75	Weiser & Lower Payette Valleys
11/8/2016	20	Central
11/8/2016	50	Southeast Idaho
11/8/2016	24	Weiser & Lower Payette Valleys
11/9/2016	88	Central
11/9/2016	40	Southeast Idaho
11/9/2016	11	Weiser & Lower Payette Valleys
11/10/2016	115	Central
11/10/2016	10	Eastern Idaho
11/10/2016	90	Southeast Idaho
11/15/2016	60	Southern Magic Valley
11/22/2016	15	Northern Magic Valley